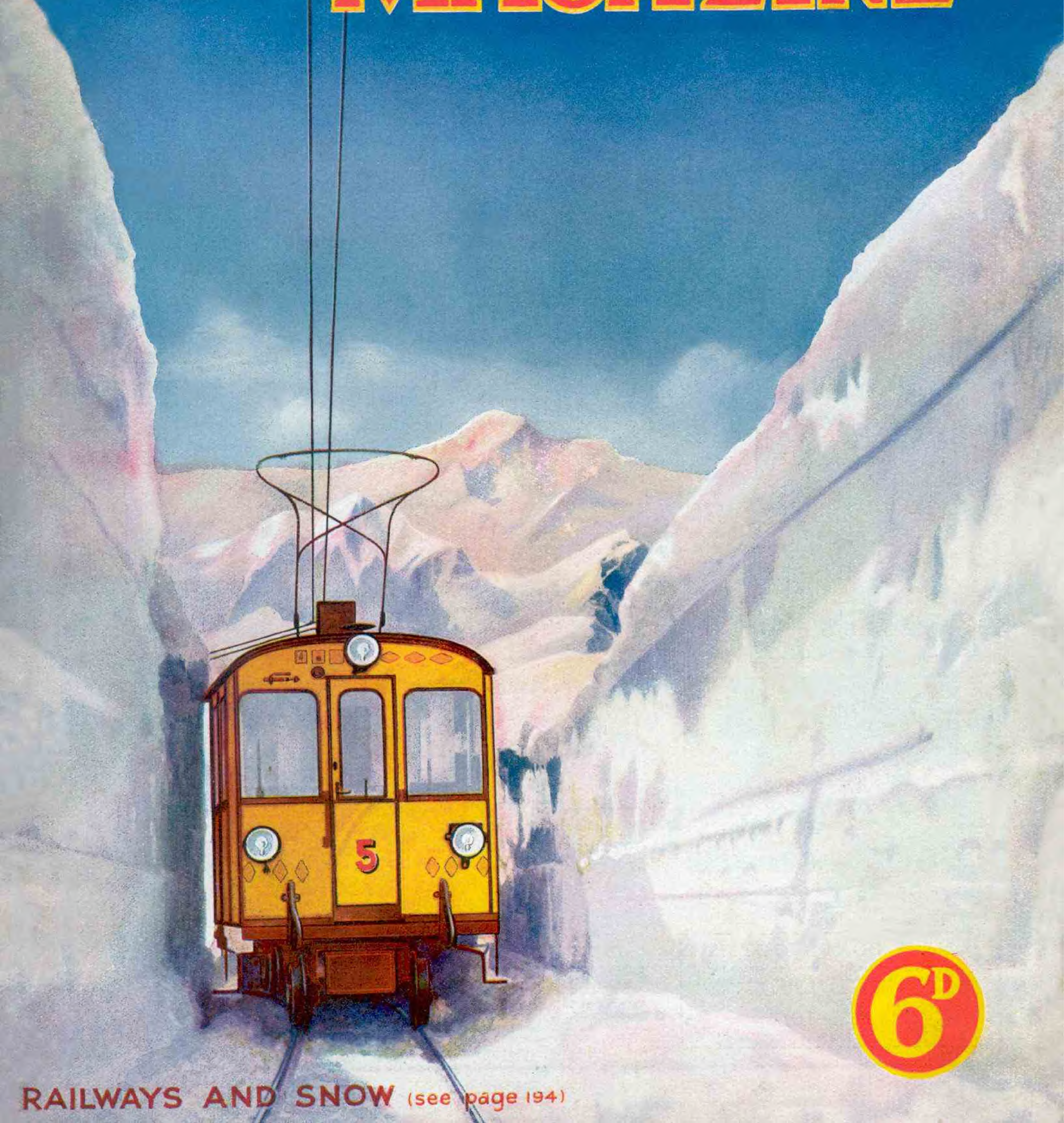
VOL XIII NO 3 MARCH 1928.

MECCANO MAGAZINE



RAILWAYS AND SNOW (see page 194)

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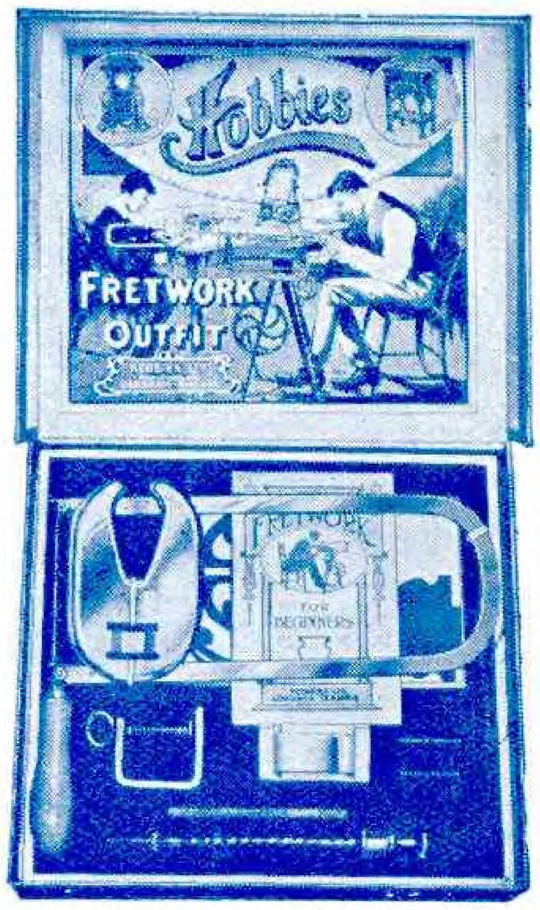
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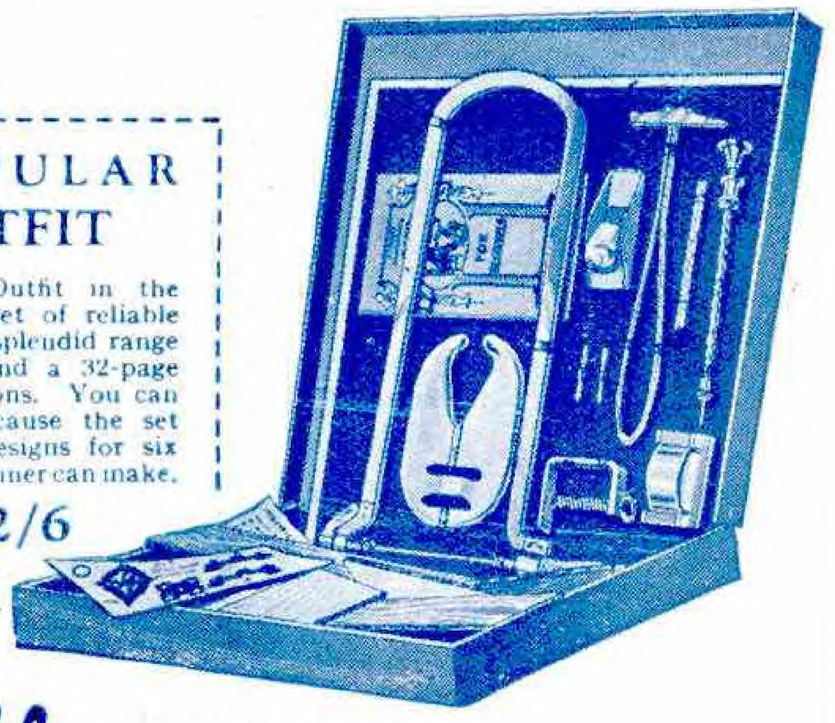
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March, 1928

With the Editor

The Man Who Completed the Panama Canal

The announcement in New York on 21st January last of the death of Major-General Goethals recalled the dramatic days of the building of the Panama Canal. The story of this great engineering feat was related in the "*M.M.*" recently, but limitation of space forbade anything in the nature of a character sketch of the man under whose guidance the canal was successfully completed. He was such an interesting personality that I am making him the subject of my editorial this month.



George Washington Goethals was born in Brooklyn, New York, on 29th June, 1858. The name Goethals is said to mean "good neck" or "stiff neck," and to have originated with one of his ancestors who, in battle, was dealt a terrible blow on the neck, but survived it owing to the excellence of his armour and his physical strength. When 18 years of age Goethals entered the College of the City of New York, transferring in 1879 to West Point where he graduated in the following year.

Goethals chose the engineering branch of the Army as a career, and his first job was with the Corps of Engineers at Willetts Point, New York. Later he was sent to Cincinnati as assistant to Lt. Col. W. E. Merrill, who was engaged in carrying out improvements to the channel of the Ohio River in the vicinity of Louisville. Merrill was one of the most successful officers of the Corps and under his excellent tutorship Goethals made great progress. Subsequently he assisted Merrill in carrying out river improvements near Pittsburg.

By the close of 1891 Goethals, then 33 years of age, had attained the rank of captain. The first big engineering task to which he was subsequently appointed was the construction of the Muscle Shoals Canal on the Tennessee River. He set about the job with characteristic energy, planning out the work according to his own ideas and exercising his gift of organisation. Before this commission had been fully carried out, however, he was summoned to Washington to take up an appointment as assistant in the office of the Chief of Engineers, and in this capacity he served until the outbreak of the Spanish-American War in 1898.

He was then appointed Chief Engineer of the 1st Army Corps and sent with them to Porto Rico where, under his supervision, many engineering problems appropriate to war activities were successfully dealt with. His habit of adapting whatever material was at hand to serve his purpose sometimes got him into trouble, while his practical enthusiasm on occasions was interpreted by others, steeped in Service routine, as deliberate defiance. One instance will serve to illustrate this.

Goethals was ordered by his commanding officer to build a wharf to enable military stores to be landed. He conducted a party of his men to the shore to commence operations, and found the beach being lashed by heavy waves. A short distance away he espied several barges that the Navy had appropriated as war booty. He immediately ordered his men to take one of the barges, tow it to the site of the wharf, and, by loading it with sand, sink it to form a foundation for the wharf. When this barge had been sunk a second one was appropriated, and his men were about to load it when a terse order was received from the Admiral that the commandeering of Naval property must cease immediately. Goethals replied that he was acting under orders from his superior officer and was not prepared to accept instructions from any other source.

When this reply was reported to the Admiral he at once retaliated with the threat that if Goethals did not leave the barges alone his party would be fired upon. Undismayed by the threat, Goethals invited the Admiral to "fire away." Instead of doing so the latter complained to Goethals' commanding officer, and as a result Goethals was instructed not to annoy the Admiral by stealing his barges, but to construct the wharf of lumber. Goethals replied that he had no lumber and that none was obtainable—and went on using the barges!

After the war Goethals was stationed at West Point, and three years later he was posted to Newport, R.I., as Officer-in-charge of Fortifications. He was by now a Major of the Regular Army. Subsequently he was appointed a member of the General Staff, stationed at Washington, and he also became a member of the Board of Fortifications.

During 1906 President Roosevelt visited the Panama Canal zone and, after a careful inspection of the works, felt very dissatisfied with the progress that had been made. He decided that a drastic change of administration was advisable, and when the resignation of Stevens, the civilian chief engineer at Panama, was received at Washington early in the following year, Roosevelt seized the opportunity. Turning to Mr. Taft, then Secretary for War, he declared: "I've tried two civilians in the canal and they've both quitted. We cannot build a canal with a new chief engineer every year. Now I'm going to give it to the Army and to somebody who can't quit." Characteristically he added: "I'll put a man there who'll stick to it if necessary till the Judgment Day. Send for Goethals."

The first intimation that Goethals had that anything important was in the wind was an invitation by telephone from Taft, and on the same evening he was summoned to the White House to interview the President. Roosevelt received him cordially and explained the nature of the appointment, emphasising that the one thing he most desired was to avoid the frequent changes of management that so far had prevented any definite policy being worked out at Panama.

The subsequent arrival of Goethals in Panama marked the beginning of a new chapter in the history of the canal. At that time the many thousands of labourers from the British W. Indies were very discontented as the result of the American overseers and foremen treating them as common American "niggers." Goethals immediately issued an order that anyone in authority found guilty of abusing or striking a coloured man would be dismissed instantly, and from that time onward the coloured British labourers worked well and contentedly.

The canal was completed in 1914 and in 1915 Goethals was made Major-General and the first Civil Governor of the Canal Zone. He retired from the Service in March 1919 to become the head of an important engineering organisation.

How Railways Fight Snow

Drifts and Avalanches in Switzerland

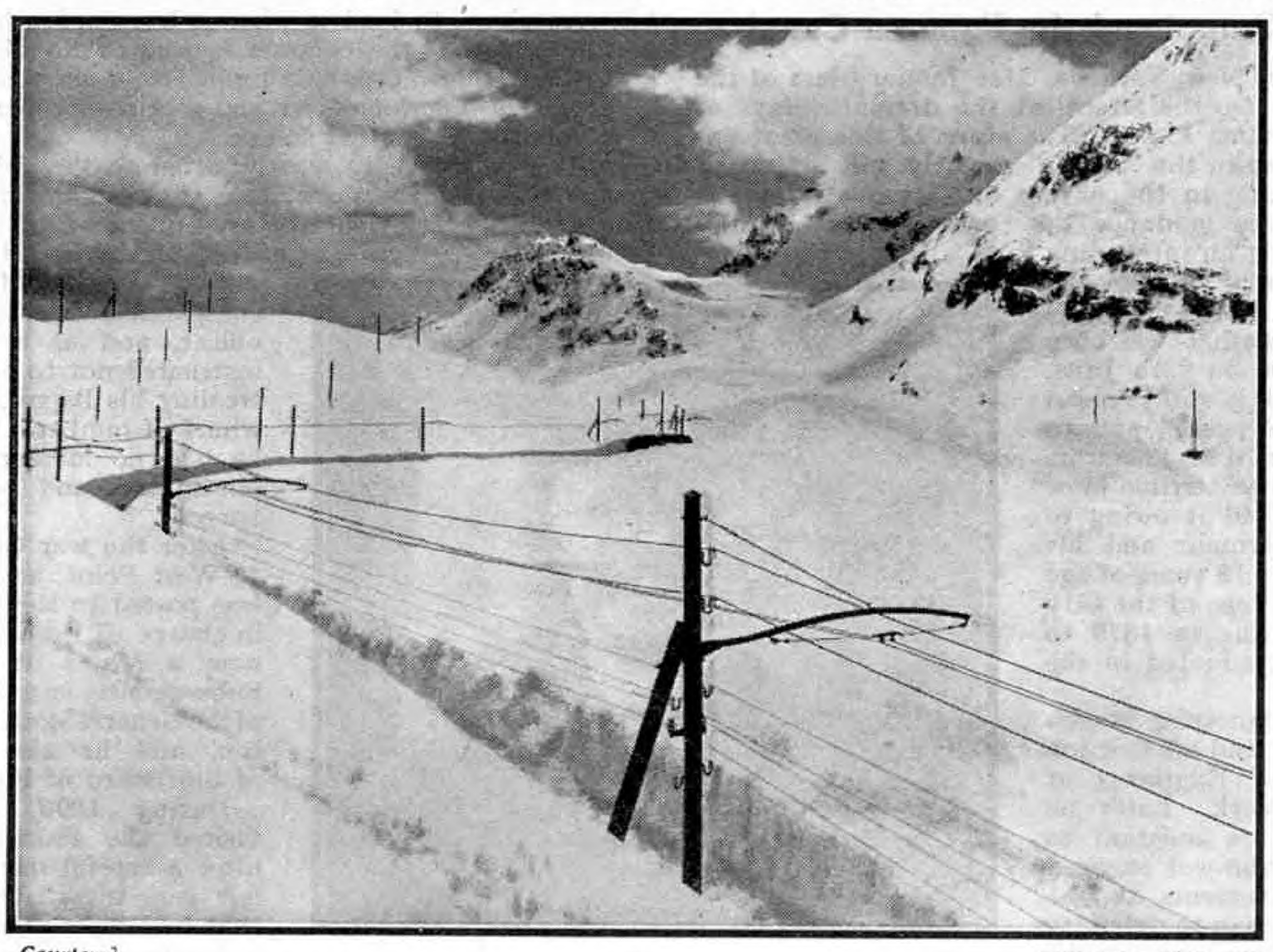
By Cecil J. Allen, M.Inst.T., etc.

LAST Christmas brought with it the most potent reminder that Great Britain has had for many years in regard to the power of snow to interrupt transport of all kinds. Railways were among the worst sufferers. It is not so much the depth of the fall that creates the difficulty, although that may be serious enough; it is the unfortunate tendency of snow to drift, under the influence of high winds. In this manner a road or a railway track may be buried under an accumulation of snow many times the actual depth that has fallen.

This was the trouble in the week between Christmas and the New Year, and it was accentuated by the fact that a strong north-east wind, continuing through most of that week, drifted the snow back very soon after it had been cleared, and in some cases to a worse depth than before. It is very singular to reflect, too, that the deepest falls did not take place, as one might expect, in the Highlands of Scotland, but in the counties to the south and west of London. Deep railway cuttings suffered most; one drift on the west of England main line of the Southern Railway, between Basingstoke and Salisbury, was 15 ft. in depth, and another, on the Amesbury branch, was no less than 18 ft. deep.

For many reasons, of which snow forms but one, railway operation is much more troublesome and more costly in winter than in summer. Fogs interfere with the visibility of the signals, and the platelayers—whose normal work of looking after the track cannot, in any case, be carried on, owing to the risk the men would incur of being run down—have to be stationed at the signal posts, in order to convey to drivers, by means of detonators or explosive fog signals, the signalling indications that cannot be seen. The extent of fog signalling can be realised from the fact that one British railway group alone keeps half a million detonators in stock in readiness for emergencies.

Frost is another source of trouble, for it tends to get into cracks in railway banks and to split them up and so cause landslips. Still worse is the "silver thaw," or rain that freezes on the ground as it falls. This locks switches in position so that they cannot be moved, and glazes over the conductor rails of electric railways, thus bringing the traffic completely to a standstill. We had a striking example of "silver thaw" on the Wednesday before Christmas.



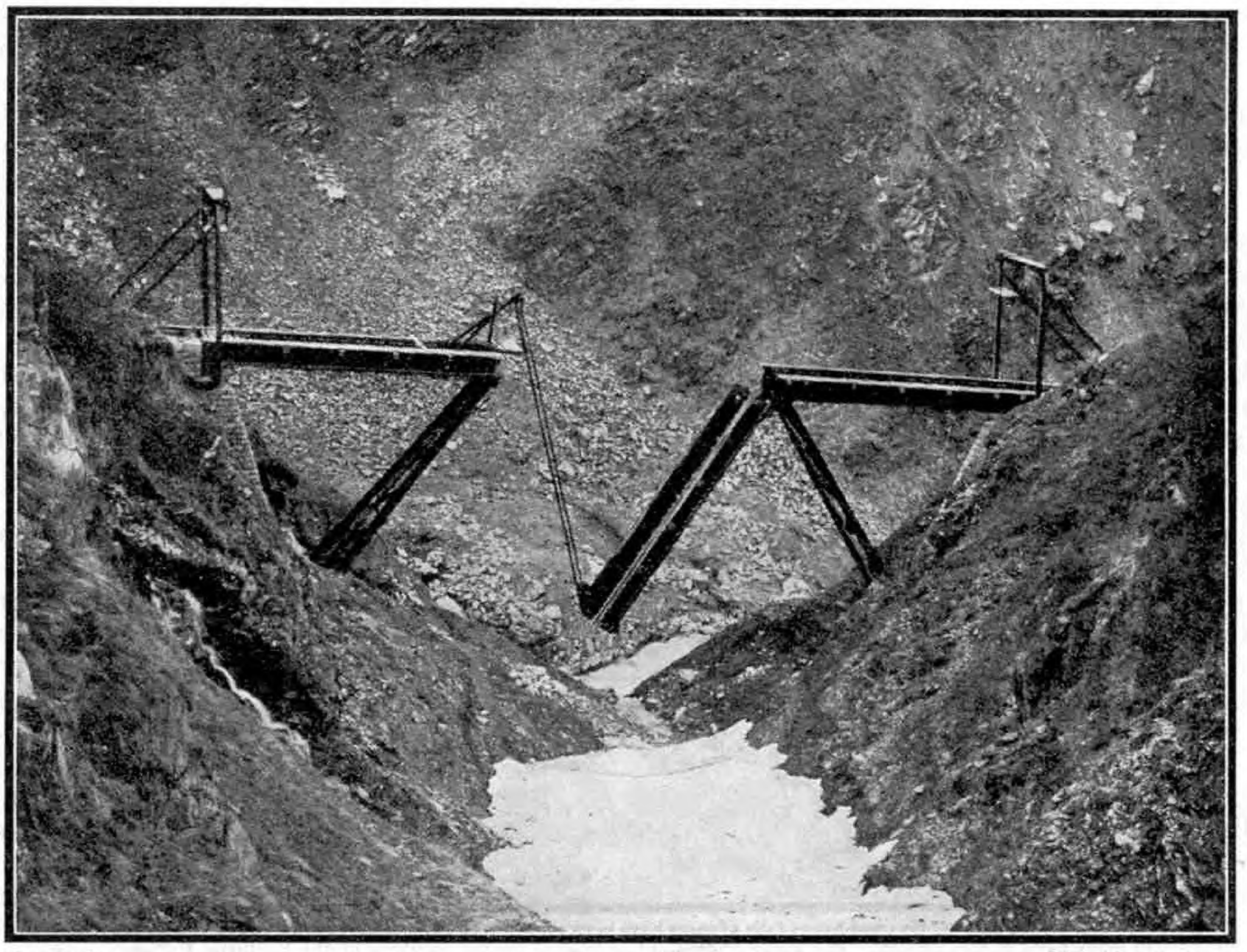
Courtesy [*Rhaetian Railways*

What winter snow means to a Swiss Mountain Railway. A 15-ft. drift at the summit of the Bernina line, 7,400 ft. above sea-level. The top of electric train is just seen in the middle distance

The effects of snow in connection with railways are exceedingly interesting and are worth consideration in detail. While snow is falling it has the same adverse effect as fog on the visibility of signals, and cautious running with consequent delay is practically inevitable. It is with its removal when it has fallen that we are most concerned, however. In southern England such a visitation as that of last Christmas is fortunately a very rare occurrence and in consequence few serious precautions need be taken to combat the difficulty. In the north-east of England, however, and still more in the Highlands of Scotland, every winter brings its heavy snowfalls, with the attendant expense of keeping the lines clear. On certain routes, exposed stretches of line where drifting of snow is prevalent are protected by means of "snow fences." These are lengths of stout fencing usually made up of rows of second-hand sleepers standing up on end, and their purpose is to prevent drifts from forming. Such "snow fences" may be seen along various parts of the Highland section of the L.M.S. railway between Blair Atholl and Kingussie, which goes through the heart of the Grampians by means of the Drumochter Pass, at a level of 1,484 ft. above the sea.

But "snow fences" are no protection, of course, against the settling of the snow. To deal with this, along the unprotected lengths of line, it is necessary, for a reasonably rapid clearance, to employ a snow-plough.

The snow-ploughs used by British railways are of two types. First there is the plough of sheet steel shaped like the ram of a battleship, which is mounted in front of the buffers of the locomotive and, being pushed forward steadily from behind, shoulders the snow to right and left of the track as it advances. A more ambitious type of plough is an independent vehicle, with a similar ram in front but extending the full height of the loading gauge, with a compartment at the rear end for the accommodation of the snow-clearinggang. This is pushed by two or more locomotives. In the case of drifts it is generally necessary to back the plough and then charge the drift at speed, which may have to be done for a number of times in succession before the road is clear.



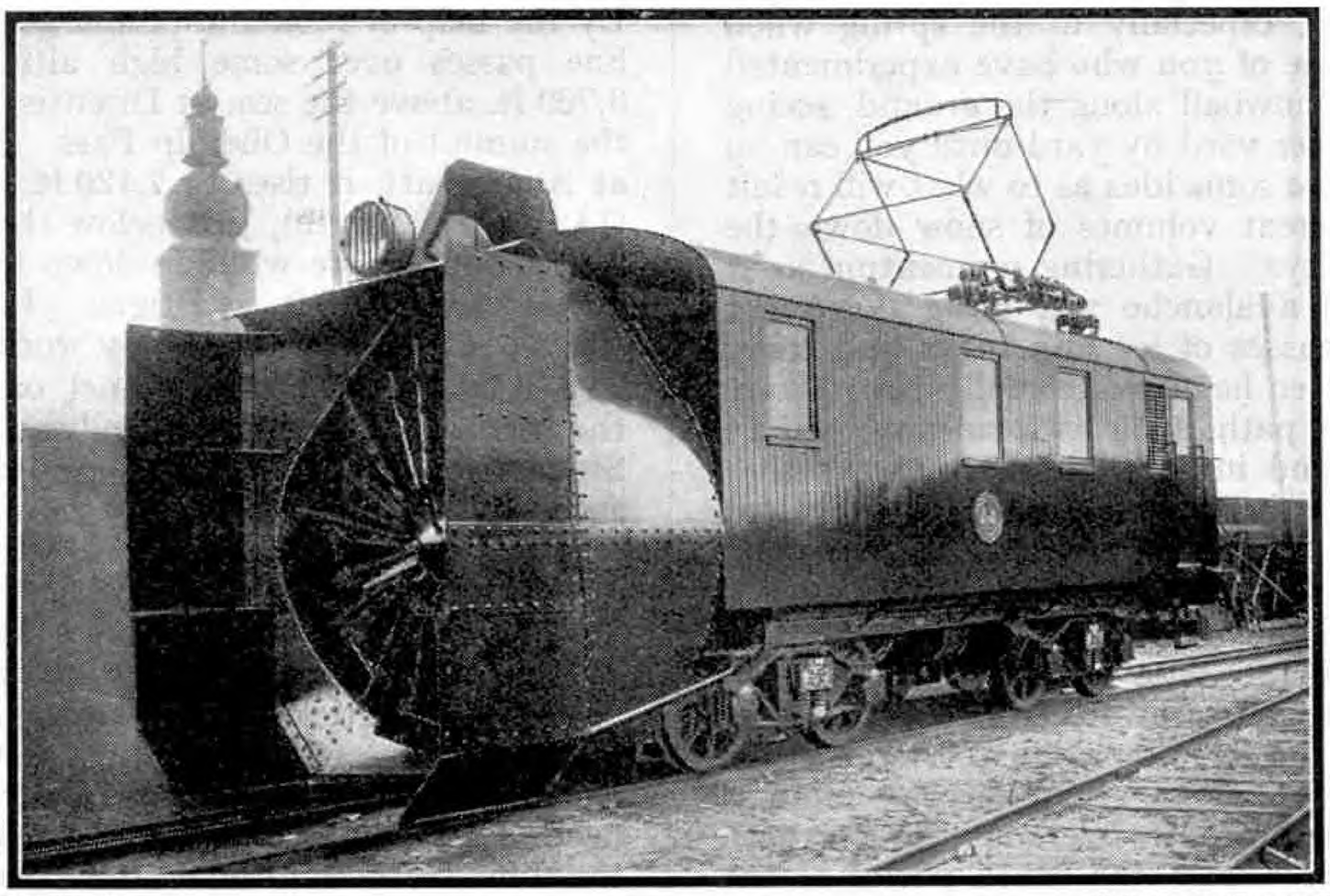
Courtesy [*Rhaetian Railways*

Preparing for the winter avalanches. Steffenbach Bridge, Fürka-Oberalp Railway, Switzerland

During heavy snowfalls these ploughs must be kept patrolling the lines unceasingly in order that there may be no interruption of traffic. Even then, however, the snowfall is sometimes so heavy as to defeat all the efforts of the plough and for a time cause a complete hold-up.

As we have seen, snow can produce serious trouble on British railways, but the difficulties encountered here are insignificant compared with those in a mountainous country like Switzerland, especially in the case of some of the mountain lines that pass over very high altitudes. Some of these lines are closed to traffic throughout the winter, during which period they are buried completely in snow; but those that afford through communications have to be kept open. Among the latter the most striking example is perhaps the Bernina Railway. This forms a continuation from St. Moritz and Pontresina, in the world-famous Engadine, of the Rhaetian Railways, the main system of the mountainous Canton of the Grisons. The summit of the Bernina Pass, over which the railway is carried, is at an altitude of 7,400 ft. above the sea, and the snow gauge at the Bernina Hospice shows that the maximum winter fall of snow since the opening of the railway has been 17 ft. 9 in. This, it must be remembered, is a general depth, and not merely the depth of a drift in some cutting.

Along the most exposed lengths of the line, between the Bernina Hospice and Alp Grüm, where drifting would cause serious difficulties, snow sheds have been erected. These are of timber construction, resembling tunnels, the railway being completely roofed over. The snow sheds are of limited length, however, and for all the open stretches of line the constant running of snow-ploughs is necessary when snow is falling or drifting.



Courtesy ["*Railway Gazette*"

Electrically-driven Rotary Snow-plough as used on the Swedish Riksgrans Railway

An ordinary battleship type of plough would be useless with such depths of snow, and recourse must be had, therefore, to the rotary plough. Rotary ploughs were first introduced by the American and Canadian lines crossing the high

passes of the Rockies. The plough itself consists of a huge vertical wheel arranged at right angles to the track, on the spokes of which are mounted large curved knives. This forms the leading end of the plough equipment, the rear end consisting of a powerful steam locomotive. As the locomotive slowly advances, the plough itself is made to revolve rapidly by steam power, and the curved knives cut through the snow at high speed, throwing it clear of the track in a tremendous shower. The depth of cut of which the rotary plough is capable is clearly apparent on the front cover of the present issue, which shows the Bernina electric train passing through at a point near the Hospice.

It is singular to note, in the case of the Bernina Railway, that the two rotary ploughs are the only steam locomotives on the line; and to their credit be it said that the electric motors are powerless until the steam ploughs have done their work of snow clearance.



During the past winter some heavy falls of snow have been experienced in England and the railways suffered in many parts of the country. The above photograph, published by the courtesy of the Southern Railway, shows the unusual spectacle of locomotives embedded in snow in one of the southern counties of England. These locomotives were attached to a snow-plough in an attempt to clear the line at Amesbury, Wilts. In this they were unsuccessful, however, for the snow was 18 ft. deep in places. In the end assistance had to be sent to dig out the snow-plough and the locomotives.

So far we have considered snow only as an obstruction to railways, but it can also be a very real danger. Masses of snow accumulated high up on the mountain sides sometimes break loose, especially in the spring when the thaws begin. Those of you who have experimented with the rolling of a snowball along the ground, seeing it grow bigger and bigger yard by yard until you can no longer move it, will have some idea as to what will result from the rushing of great volumes of snow down the mountains to the valleys. Gathering momentum as it slides, the really bad avalanche will bring down not only snow but also masses of ice and rocks and trees. Thus it can be, and often has been fearfully destructive. Any obstruction in its path, such as a railway, will be readily swept away, and in consequence railways that pass through regions where avalanches are prevalent have to be specially protected against their damaging effects.

In Switzerland the most complete example of this avalanche protection is found on the line of the Lötschberg Railway, which runs southward from Spiez, on the Lake of Thun, to join the Simplon route at Brigue at the entrance to the Simplon Tunnel, giving direct communication from Berne and Central Switzerland into Northern Italy. The line emerges from the south portal of the great Lötschberg Tunnel into the inhospitable Lonza Valley at Coppenstein, and from there, as the track is carried high up the precipitous east side of the valley, and later along the north side of the Rhone Valley, avalanche tunnels are frequent. For the most part these are like cuttings in the mountain side covered over with sloping roofs which throw the snow and other debris clear of the railway track, and they have been built at points where the railway crosses known avalanche tracks down the hillsides. Some of the earlier avalanche shelters were timber structures, but these have now almost entirely been replaced by solid constructions of masonry.

The builders of the Lötschberg line had every reason to respect the power of the avalanche. More than once the workings at the southern portal of the tunnel were buried to a depth of as much as 80 ft., and on one disastrous February night the whole of the construction camp at Goppenstein was overwhelmed by a colossal avalanche and swept to the bottom of the Lonza Valley below.

Last summer, during a tour that carried me right across the centre of Switzerland from Pontresina in the Engadine to Kandersteg on the Lötschberg line, I saw one most ingenious protection against avalanches. This was while coming across the recently opened Fürka-Oberalp Railway, which cuts across from the Rhine Valley at Disentis, past the Rhone Glacier to the Rhone Valley at Brigue. By the help of rack-and-pinion gear the Fürka-Oberalp line passes over some high altitudes. Beginning at 3,760 ft. above the sea, at Disentis, it attains 6,720 ft. at the summit of the Oberalp Pass. Dropping to 4,735 ft. at Andermatt, it rises to 7,120 ft. at the Fürka Tunnel ($1\frac{1}{8}$ miles in length), just below the crest of the pass of that name, before winding down to 5,710 ft. at Gletsch and later to 2,315 ft. at Brigue. Except for the Gletsch-Brigue section the line is only worked in summer.

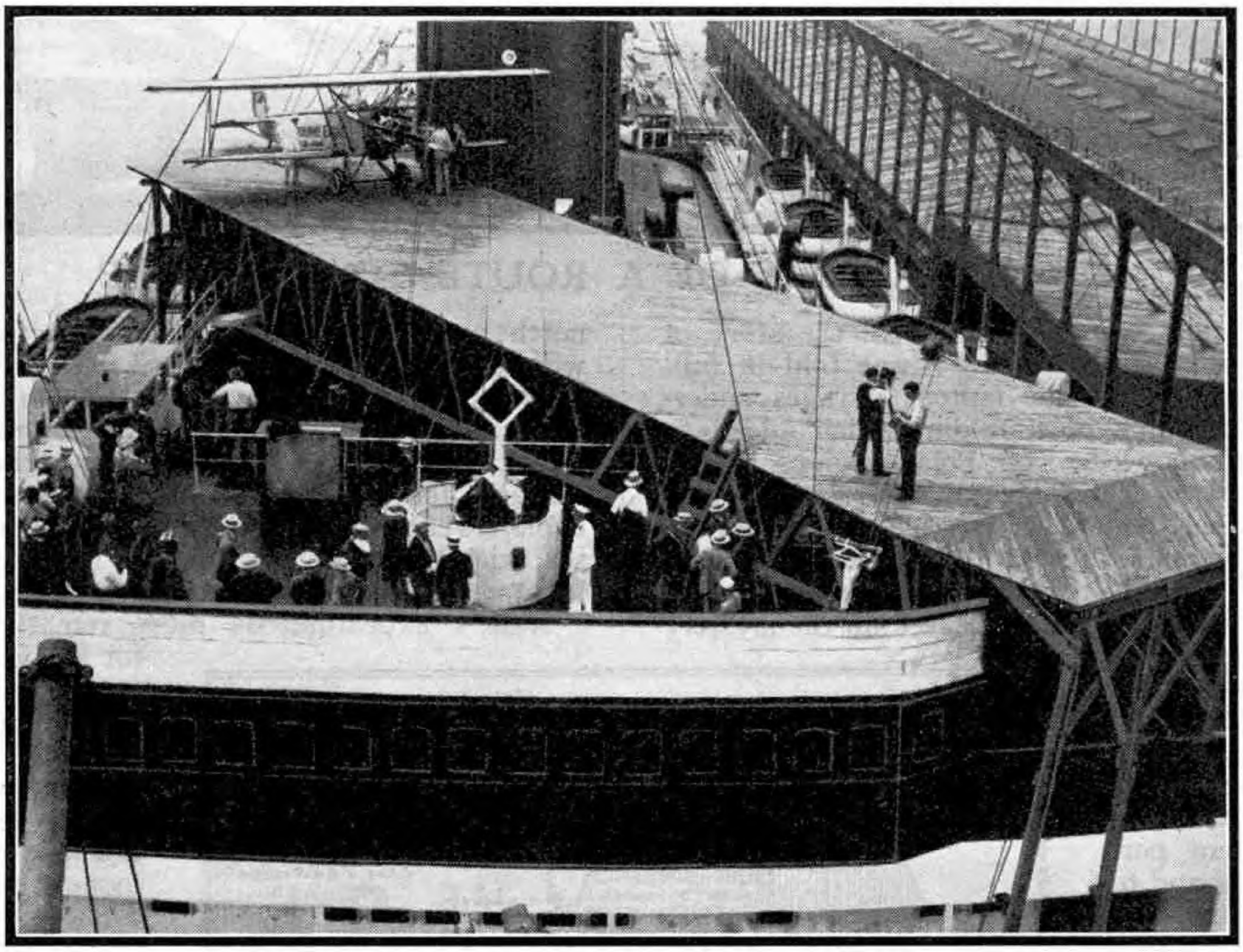
Just below the Fürka Tunnel, on the Andermatt side, the bridge carrying the railway across the narrow Steffenbach Gorge was swept away by avalanches in two successive winters. The cost of such frequent replacements could not be tolerated, so the ingenuity of the engineers was set to work with the result that a real "Meccano" structure has now been designed. It is, in fact, a bridge that takes to pieces.

The two vertical supports are hinged at their bases and the three sections carrying the track are also hinged. At the conclusion of the summer traffic the various connecting bolts are withdrawn and a crane neatly folds over the track sections, bringing them back on to the two sides of the gorge. At the same time the vertical supports are swung back against the slopes, leaving the whole centre of the gorge clear for the avalanches to do their worst. The same process is reversed in the late spring, when the Fürka-Oberalp line is reopened for traffic.

Speeding Up The Mails

From Ship to Shore by Aeroplane

THE most interesting development of commercial aviation within recent months is the outcome of interesting experiments in mail-carrying work recently carried out by Canadian and United States airmen. The possibility of speeding up the delivery of the trans-Atlantic mails by employing aircraft to take mails to steamers already a day or two out on their voyage, and from steamers when they are still a day or so away from their destination, had long been discussed in aeronautical circles but it was left to America to test the proposition. So successful were the trials that the scheme is already in full operation in connection with certain inward-bound Canadian mails. These are taken off the steamers close to Father Point on the River St. Lawrence and flown approximately 185 miles to Quebec, from which point a further distribution by air to Ottawa, Montreal and Toronto effects a 48-hour saving over the steamer-port-railway service.



The specially built runway over the "*Leviathan's*" bridge from which Clarence D. Chamberlin, in a Fokker-Wright 'plane, flew to New York from the liner the day after the ship sailed

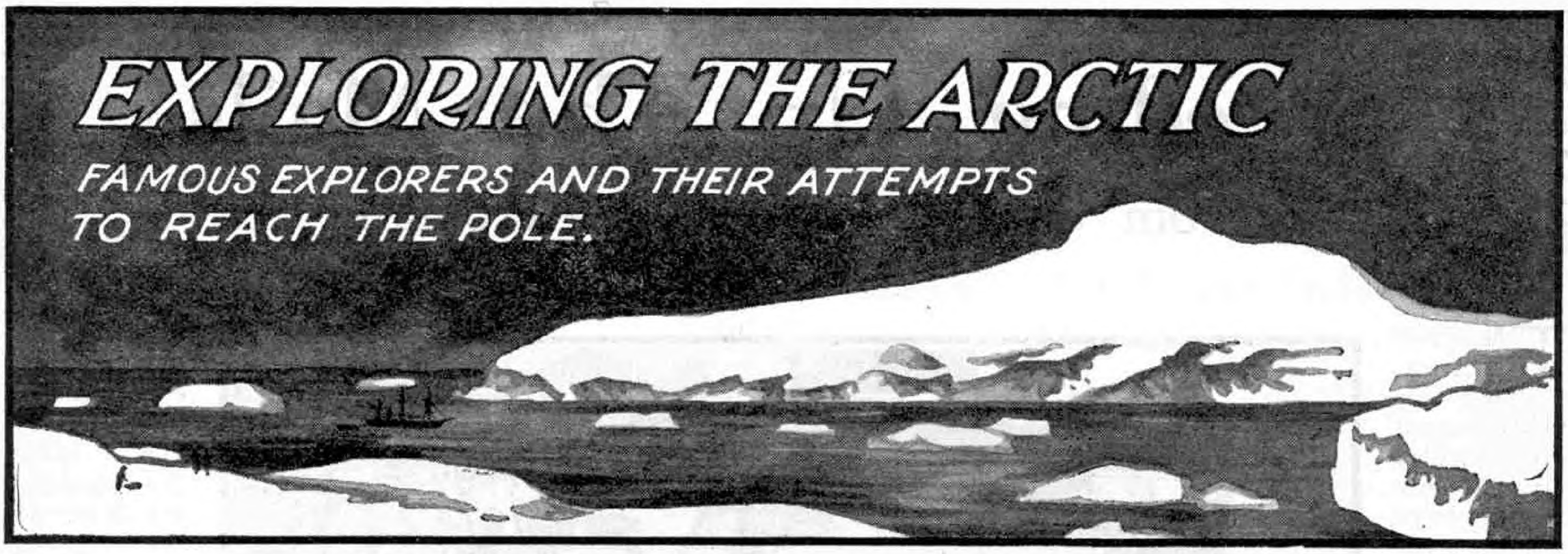
This mail collection from and delivery to steamers far out at sea is no "stunt." Time is money and the saving of precious minutes in the delivery of mails is a matter of vast importance to governments and business houses.

The first experiments in taking off from a passenger liner were made by the American airman Clarence Chamberlin, the pilot of the 1927 New York–Berlin non-stop flight, and the story is one of great interest.

Above the boat deck of the famous American liner "*Leviathan*," which was used for the experiment, a broad runway 114 ft. in length was built. This extended from the starboard side of the front funnel to the port side of the deck above the bridge. In order to assist the "take off" the runway was inclined at an angle of three degrees, with a levelled-off portion toward the bow end to eliminate a diving tendency after the machine got clear. At the time of making the test there was a breeze of approximately 15 m.p.h. and the "*Leviathan*" was steaming at about the same rate. The ship was manœuvred so that the wind was blowing practically along the runway from bow to stern, and this gave an approximate wind velocity in relation to the ship's speed of 20 m.p.h.—almost ideal conditions.

Chamberlin used a Fokker biplane equipped with a Wright "Whirlwind" engine, and carried sufficient petrol for a two hours' flight. Only a comparatively light load, consisting of 900 letters, was carried, a factor that was of considerable importance in view of the comparatively short run that the machine had before the take-off. Actually, Chamberlin had only a distance of 75 ft. in which to work, and his difficulties were not lessened by a sudden squall of driving rain.

The "*New York Times*" gives an interesting description of the actual start of the flight: "The flier played with the controls for the moment, testing his rudder, the ailerons and elevator. Four short blasts came from the "*Leviathan's*" siren, then the motor roared and the 'plane answered. The tail rose to flying position. Chamberlin gave the engine full throttle, pushed his stick forward, jumped his blocks and shot down the runway . . . the 'plane was off at 75 ft. Instantly the pilot lifted his 'plane into an almost perpendicular climb to an altitude of 500 ft. As the 'plane slowed almost to the stalling point Chamberlin pulled it over in a slow backward turn and straightened out to dive back towards the "*Leviathan.*" As he swooped down he pulled back his stick and zoomed high over the masts."



XVII.—DISCOVERY OF A ROUTE TO THE POLE

IN two recent numbers of the "*M.M.*" the story of M'Clintock's expedition of 1857 was told in full.

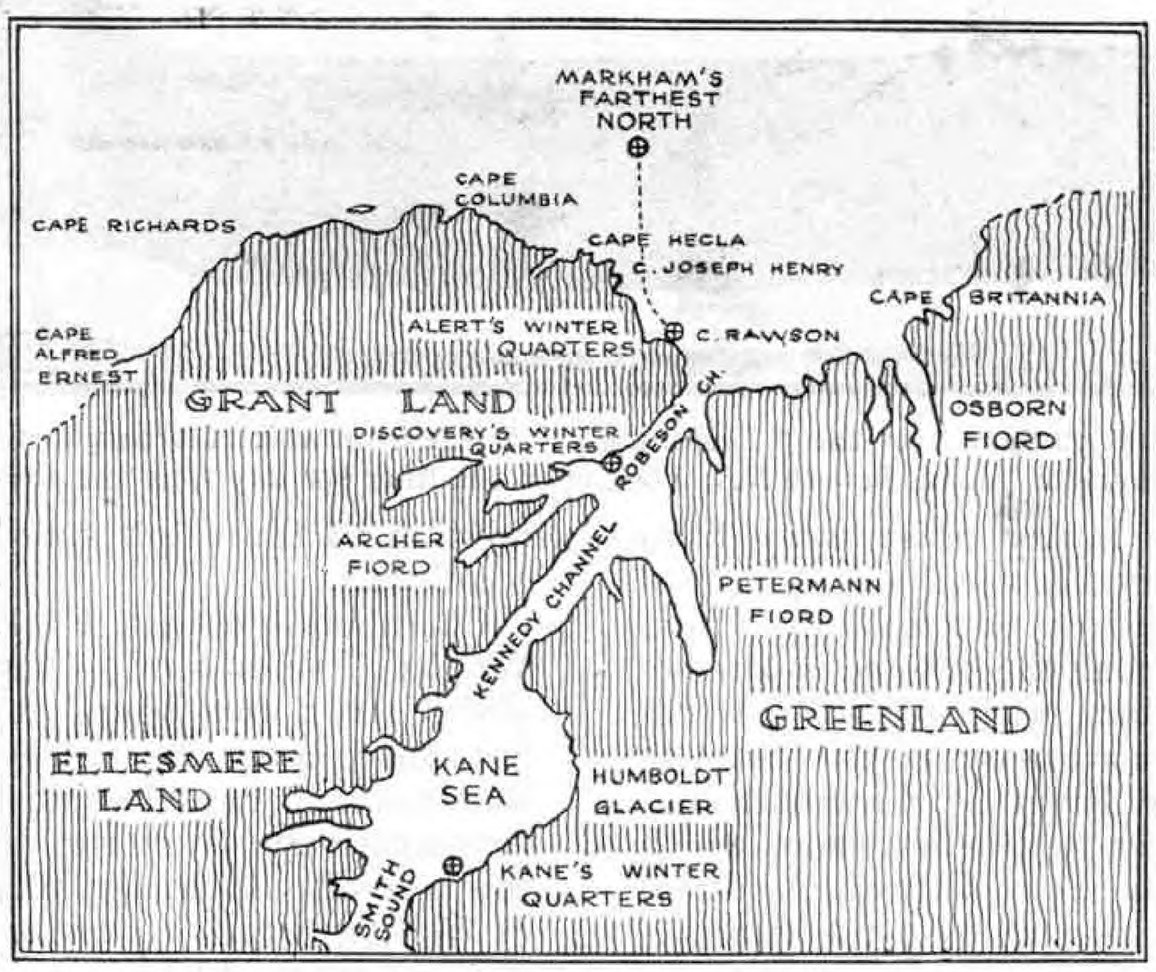
This was the last of the famous voyages undertaken mainly in search of Franklin, which added so greatly to our knowledge of Polar regions. After M'Clintock's return the scene of interest changed. The search for the North-West Passage and the efforts to trace Franklin had directed the attention of most Polar explorers towards the archipelago to the north of Canada, but when M'Clintock cleared up the mystery of the lost expedition, and the North-West Passage proved to be of no practical value, the attention of explorers was directed towards the unknown northern portion of Greenland and to attempts to reach the Pole itself.

Even before the search for Franklin ceased some efforts had been made in this direction. It has already been noted in the "*M.M.*" for August that Inglefield sailed up Smith Sound in 1852 and discovered that it led into a wider sea. The American, Kane, followed the same path in 1853 and succeeding in penetrating still farther north. His ship, the "*Advance,*" was compelled by ice conditions to winter in a bay on the Greenland shore of the sea now named after the leader of the expedition, but parties from it explored and mapped the coast on both sides of Kane Sea and still farther north for a distance of nearly 200 miles. The most remarkable discovery made by this expedition was the Great Humboldt Glacier, which stretches from the central snow-capped heights of Greenland to the shore of Kane Sea on a front of more than 60 miles.

Other discoveries gave rise to much discussion. Morton and an Eskimo named Hans, the two members of Kane's expedition who made the farthest north journey, returned with news of open sea still farther to the north, and believed that they had reached the north coast of Greenland. There were some people who said that an open Polar sea was just what they had expected, but on the whole Morton's "discovery" was a great surprise and was afterwards proved to be a mistake. In some respects it was perhaps a fortunate mistake, for the story of open water attracted many explorers eager to reach the Pole by crossing the mythical sea, with the result that the seas north of Smith Sound became almost as well-known as Baffin Bay.

Kane's expedition is most remarkable, however, for the wonderful escape from starvation after the "*Advance*" was abandoned. For this the members were greatly indebted to the friendly Eskimos who were found living in that inhospitable country. When the decision to abandon the ship was made, after two winters in the ice, the men were in a dreadful state. Practically all of them were suffering from the effects of scurvy and only 36 days' provisions remained. Their general equipment, too, was sadly deficient. With great labour they dragged their three boats on sledges across the ice of Smith Sound with the help of the Eskimos until they came to open water and were compelled to take to the boats. These were in bad condition. A violent storm did not improve them and it was found necessary to cut up one of them in order to obtain wood to repair the others. After nearly dying from starvation the party eventually reached Greenland.

A few years later another expedition sailed to Smith Sound to verify the existence of the open Polar sea. This was under the command of Hayes, who had been with Kane and now profited by the experience he had gained, leaving his ship for the winter in a much better position for extrication in the following summer. A sledge journey to the north in search of the open sea was completely successful!



Map showing the pathway to the pole discovered by Inglefield and Kane, and the northern coastline of Greenland and Grant Land, discovered by the Nares expedition

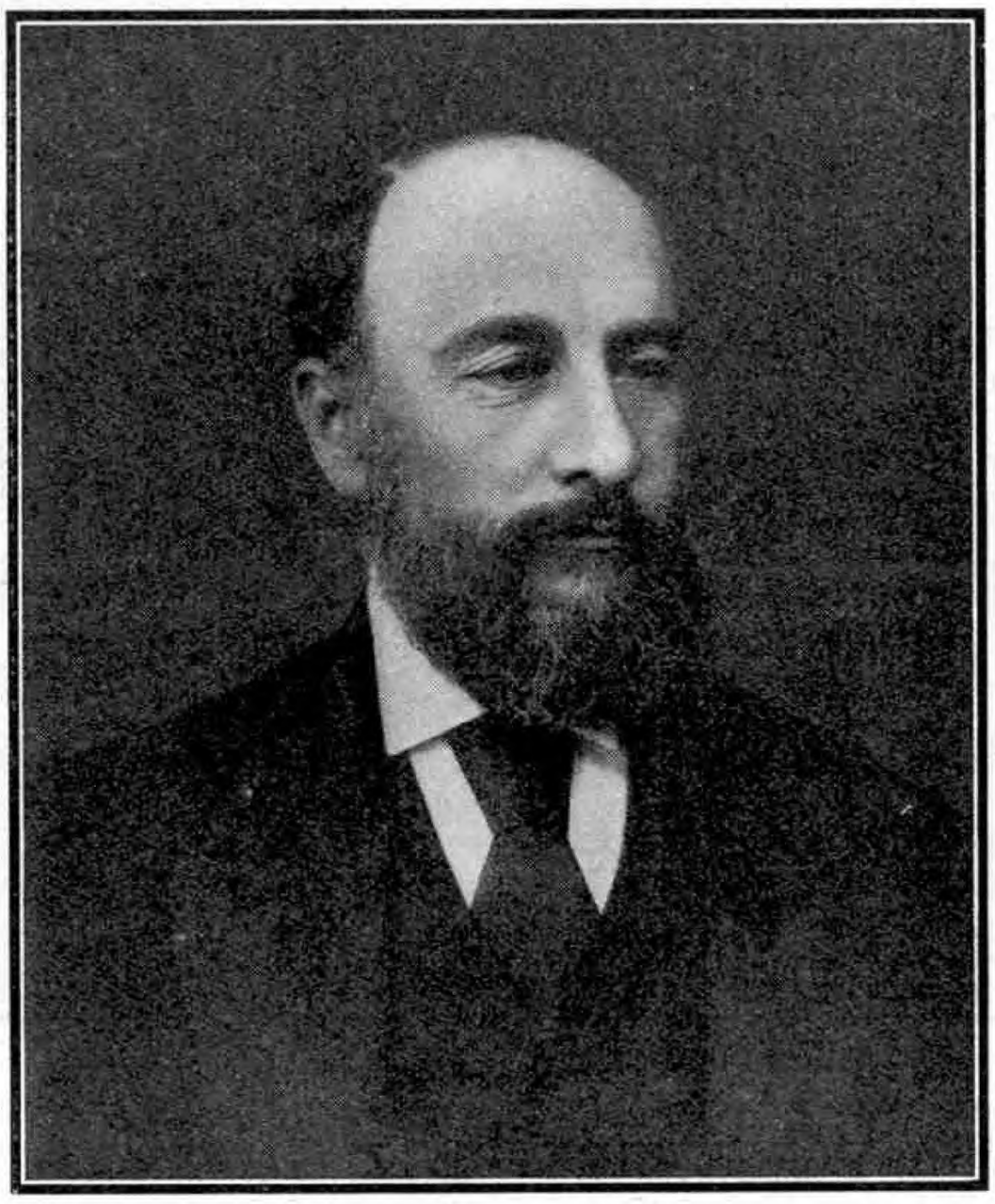
As we now know, both Morton and Hayes saw only the water of the Kennedy Channel. This was made clear by the work of Captain C. F. Hall, the American explorer who discovered further Franklin relics on King William Land, as related in January. Hall had lived with Eskimos for years and was thoroughly accustomed to their mode of living. In addition he was a careful and painstaking observer, and no man of Arctic experience was better qualified to investigate the question of the existence of open water so near the Pole as Kane and Hayes had alleged. In 1871 Hall set sail in the "*Polaris*," a small ship of 387 tons, taking with him Morton, the original discoverer of the "open sea," to show him where to find it.

The "*Polaris*" steamed through Smith Sound and across Kane Sea into Kennedy Channel. The open Polar sea proved to be a complete myth, for the Kennedy Channel only led into another channel, named by Hall Robeson Channel. Eventually a latitude of 82° 16′ N. was reached, at that time a Polar record for a ship. The leader wished to push on still farther through the ice, but agreed to the representations of his ice master and turned south at this point. Immediately the ship was beset in the ice and carried southward. Fortunately she became free again in a few days and remained for the winter in the small harbour named by the explorers Thank God Bay.

Hall achieved results of considerable importance. In five days he ran 500 miles through seas that usually had been found impassable. He completed the exploration of Kennedy Channel, discovered Robeson Channel and was the first to reach the true Polar Ocean, that proved to be icebound. A discovery as remarkable in its way as the "open sea," but one far better substantiated, was made by Hall. This was that north of Petermann Fiord a large area existed in Greenland that was free from ice and was covered with herbage on which musk oxen grazed.

Unfortunately Hall died at Thank God Bay in November 1871, and was buried close by. His death was the end of the enterprise, as the attempt was made to return southward immediately ice conditions became favourable. The adventures on the return journey were somewhat startling. As the season was a little late the ship was driven into the pack ice and anchored to a floe. In this state she drifted helplessly into Baffin Bay and the drift continued for 11 weeks. In October a violent storm arose and two huge icebergs nipped the ship, lifted her out of the water and threw her on her side. Immediately her two boats were placed on the ice, and provisions and stores were being loaded into them when the floe broke up with a roar like thunder and the "*Polaris*" disappeared in the mist. When the floe cracked some of the party were on the ice with the boats. Fortunately nine Eskimos were among the number, They set to work to build snow houses, spear seals and catch fish, and there is no doubt that their exertions saved the entire party from starvation.

The floe was about 100 yards in length to begin with, but as it drifted southward through Davis Strait it melted away until finally it was only 20 yards in circumference. One of the boats had been used for fuel during the winter and it now became necessary to take to the other. The crew was finally picked up by a sealer off the coast of Labrador, after having drifted 1,500 miles in 196 days.



George Strong Nares

Meanwhile the "*Polaris*" was blown northward and reached land at the entrance to Smith Sound. The ship was quite unseaworthy from the damage sustained in the storm that broke up the floes, and after wintering near Etah the crew built two flat-bottomed boats from her timbers and attempted to return in them during the following summer. They were rescued by a whaler from a floe in Melville Bay on which they had been compelled to haul up.

The explorations of Kane, Hayes and Hall opened an entirely new field in Arctic exploration. Public interest in Great Britain had flagged somewhat at the end of the Franklin search, but by 1875 it revived once more and a Government expedition was planned to follow the new route to the north and to make an attempt to reach the Pole, or at all events to approach as closely to it as sledging conditions on the ice of the Polar sea would permit.

An Arctic veteran in the person of Captain George Strong Nares was selected to lead the expedition. He had been with Kellett when the latter searched the shores of Melville Sound for traces of Franklin on the expedition made memorable by the dramatic rescue of M'Clure, and had taken part in some of the remarkable sledging feats of that time. On one occasion he was absent 61 days from his ship and travelled 980 miles over the ice in that time. When he was appointed to the command of the new expedition he was actually in command of the famous ship H.M.S. "*Challenger*," on which a large staff of scientists was then engaged on a voyage of research and discovery that added more to our knowledge of the oceans than any other single voyage ever made.

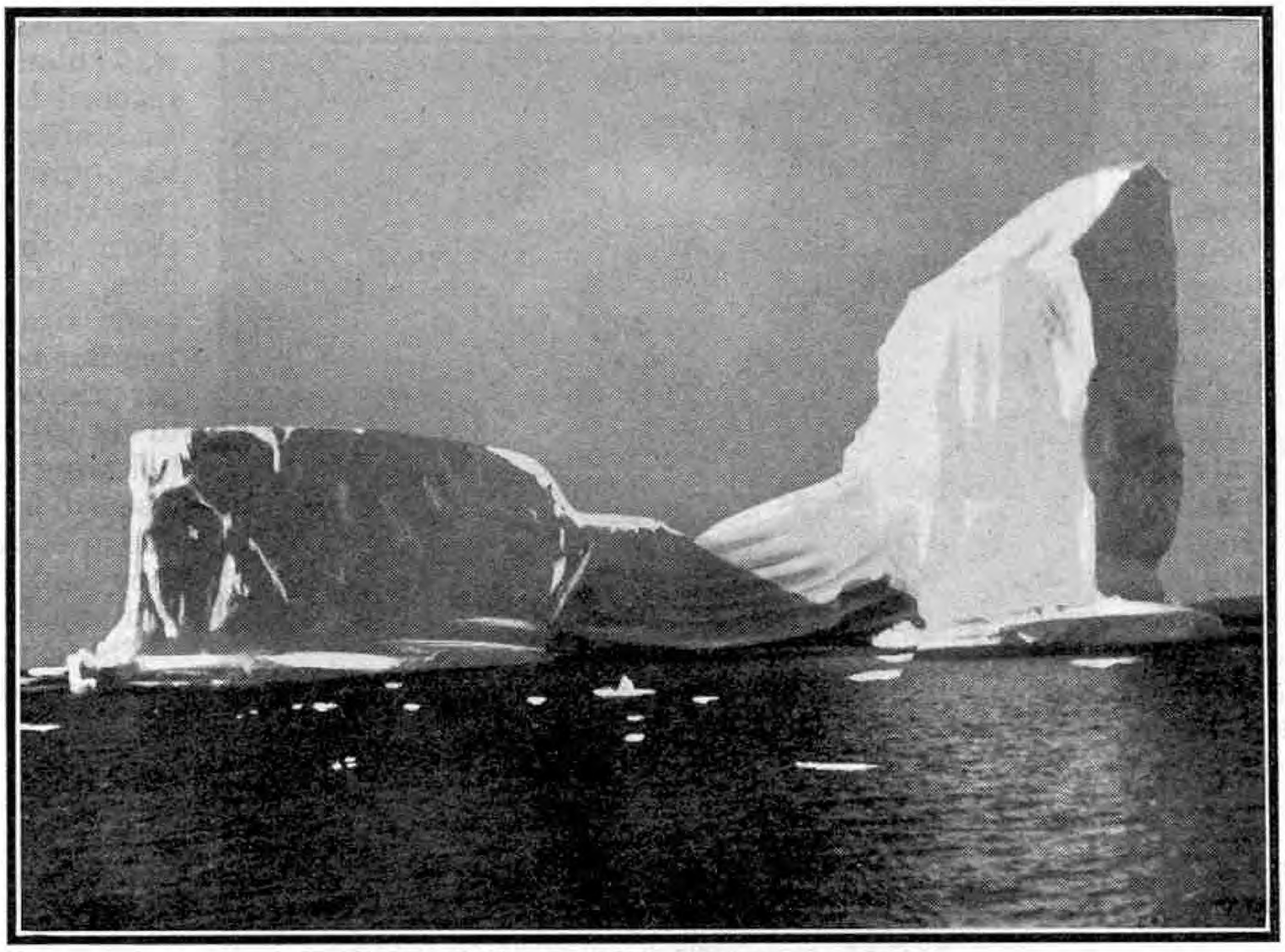
Nares was accompanied by Commander Markham, one of the most enthusiastic of Arctic explorers. So keen was Markham on Polar work that practically all his spare time was spent in whalers voyaging within the Arctic Circle. The experience gained on these voyages was of immense value to this and many succeeding expeditions in which he was interested. He had sailed the waters of Smith Sound on previous

occasions. The members of Hall's crew who, as already related, were rescued from a floe in Melville Bay after wintering at Etah, made their return to civilisation in the "*Arctic*," a Dundee whaler in which Markham was acquiring knowledge and experience of the frozen north.

The crew were carefully selected from thousands of volunteers, and this was no light task as the following incident shows. The commander of one ship called at the office in Portsmouth where the volunteers were being enrolled. "An order has come on board my ship," he said, "directing me to send volunteers for Arctic service to this office. What am I to do? The whole ship's company, nearly 800 men, have given in their names!"

Three ships were employed, the "*Alert*" the "*Discovery*," a Dundee whaler, and the "*Valorous*." The last-named was intended merely to carry stores across the Atlantic, while the other ships were specially prepared and equipped for their battle with the ice by M'Clintock, now Admiral Superintendent of Portsmouth Dockyard. The three ships left Spithead on 20th May, 1875, and arrived at Godhavn in Greenland on 6th July following. A few days later they reached Disco Bay and the "*Valorous*" then returned, after transferring her stores to the ships destined for the northern voyage.

An interesting addition was made to the party in Greenland. This was Hans, the Greenlander who had beenwith Morton when the "open Polar Sea" was first sighted. He was a boy of 19 when he accompanied Kane and had shown great prowess as a hunter during the winters he had spent with the Americans on the shores of Kane Sea. He it was who shot the rats in which Kane delighted, and which probably enabled him to keep scurvy at bay better than the members of his crew to whom the rat as a food was repugnant.



Fantastically-shaped iceberg in the Arctic

Hans disappeared before the Kane expedition turned south, and when last heard of by Kane he was driving south to another northern settlement with an Eskimo girl on his sledge! He reappeared later in the Greenland settlements and Hall took him north once more. This time a wife and three children accompanied him and they were among those members of the crew of the "*Polaris*" who underwent the perilous drift on the ice floe throughout the whole length of Baffin Bay and Davis Strait. When Hans joined Nares' expedition he wisely left his family behind.

The two vessels passed through Smith Sound with some difficulty, as it was almost blocked with ice, crossed Kane Sea and entered Kennedy Channel. Here a surprising discovery was made on a small island. This was a cairn that was certainly the work of white men and had possibly been erected by Norsemen from the ancient settlements founded in Greenland more than 1,100 years ago by Eric the Red.

The "*Discovery*" was left behind in a suitable harbour in Kennedy Channel while the "*Alert*" struggled onward to a latitude of 82° 27′, about 12 miles farther north than Hall's ship had reached. She was stopped by masses of ice ranging up to about 60 ft. in height and spent the winter there with no other protection than grounded icebergs. A vivid account of the arrival of the "*Alert*" in her northern quarters is given by Nares himself.

"The protected space," says Nares, "available for shelter was so contracted and shallow, the entrance to it so small, and the united force of the wind and flood-tide so powerful, that it was with much labour and no trifling expense in broken hawsers that the ship was hauled in stern foremost. It was a close race whether the ice or the ship would be in first, and my anxiety was much relieved when I saw the ship's bow swing clear into safety just as the advancing edge of the heavy pack closed in against the outside of our friendly barrier of ice. From our position of comparative security the danger we had so narrowly escaped was strikingly apparent as we gazed with wonder and awe at the power exerted by the ice driven past us to the eastward with irresistible force by the wind and flood-tide at the rate of about a mile an hour.

"The projecting points of each passing floe which grounded near the shore in about ten fathoms of water would be at once wrenched off from its still moving parent mass; the pressure continuing, the several pieces, frequently thirty thousand tons in weight, would be forced up the inclined shore, rising slowly and majestically ten or twelve feet above their old line of flotation. Such pieces quickly accumulated until a rampart-like barrier of solid ice-blocks, measuring about two hundred yards in breadth and rising fifty feet high, lined the shore, locking us in, but effectually protecting us from the overwhelming power of the pack."

The beach off which the ship lay was appropriately named Floeberg Beach. There the "*Alert*" remained for 11 months, with snow a foot in depth on her deck and each spar and rope doubled in thickness by the accumulation of ice. The ship was secured by cables to anchors frozen to the shore in order to protect her from gales on the landward side. To keep out the intense cold awnings were erected over the decks, while further protection was afforded by snow banked high up on each side and laid on the deck to a thickness of about one foot. The skylights and hatchways were carefully covered, two only of the latter being left open for entrance. The crews spent the winter in comparative comfort in spite of the lack of light and the intense cold.

One little difficulty due to the cold was that smoking became uncomfortable. Pipe stems of ordinary length became clogged with ice formed by the freezing of the moisture in the breath of the smokers, while the use of stems short enough to avoid this difficulty practically brought the bowl of the pipe into the smoker's mouth! Another sidelight on the cold is given by the experience of the ship's doctor in his attempt to paint flags to be carried by the various sledging parties. In spite of the large proportion of turpentine that he used, his brush froze into a solid stick every few seconds. This does not seem remarkable when we learn that even as late as 4th April the temperature was as low as 105°F. below freezing point!

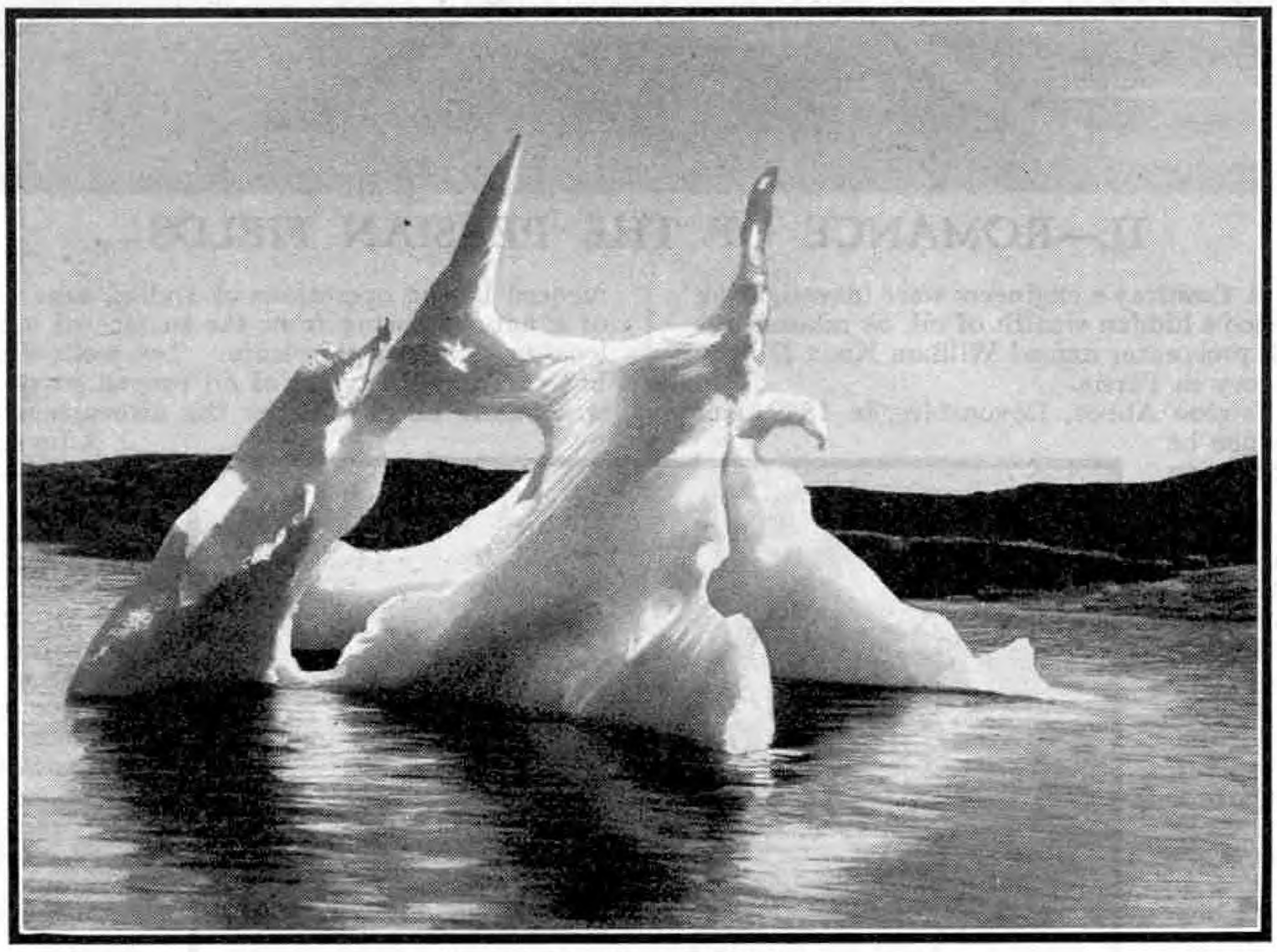
The summer sledging season at length came round and parties set off from the ship with various missions. As may be seen from the accompanying map, the position of the "*Alert*" was on the coast of Grant Land where it turned north-westward. Thus the ship was actually on the shore of the frozen ocean that surrounded the Pole. The floes were 80 to 100 ft. in thickness and the ice of which they were composed was old and its surface incredibly rugged. Sledging was therefore difficult, and after examining the prospects Nares had given a prophetic warning of this in a lecture during the winter, in which he told the men that if they could imagine the hardest work they had ever been called upon to perform in their lives, intensified to the utmost degree, it would only be as child's play in comparison with the work they would have to perform whilst sledging. His prediction was fulfilled and in the summer the men often remarked upon it during their struggles to move the sledges.

On 3rd April the sledge journeys began. One party under

Lieutenant Aldrich was instructed to explore the northern coast of Grant Land, while another under Commander Markham and Lieutenant Parr was to accompany Aldrich for a few days and then strike off northward over the ice. The former party carried out this work well, making a complete survey of the coast line for 200 miles from Floeberg Beach, in the course of which they rounded the northernmost point of Grant Land, now named Cape Columbia, and sighted Cape Alfred Ernest after following the coast for some distance to the south-west.

More interest attaches to Markham's struggle across the ice, the first of those "dashes for the Pole" that continued to be made from this neighbourhood until Peary's successful effort in 1909. Two sledges were taken, one of which was facetiously named "Marco Polo" by the men, because it was the sledge intended to be taken to the Pole. It was an eight-man sledge, 11 ft. in length and 130 lb. in weight. With a tent and necessary equipment, together with 45 days' provision for eight men, the total weight to be pulled was 1,664 lb. With seven men actually pulling, this meant a load of 238 lb. per man, more than M'Clintock allowed in the less arduous conditions met with on King William Land much farther south.

When only 11 days out, one of Markham's men complained of pains in the ankles and hands. His complaint proved to be the dreaded scurvy and soon several men were incapacitated by the disease and became unable to pull. The work was very heavy. Often the road had to be cut with pick-axes and shovels over piled-up blocks of ice, 40 ft. or more in height, amid fog, gales of wind and falling snow. At times it was only possible to proceed by moving the sledges slowly one at a time by the combined efforts of the whole party. It soon became necessary, therefore, to abandon any idea of reaching the Pole, and a party of 10 men were sent ahead to attain the farthest north.



Last stages of a giant iceberg

No sledge was taken and the walk was undoubtedly severe. "At one time," says Markham, "we were struggling through deep snowdrifts, in which we floundered up to our waists, and at another tumbling about amongst the hummocks. Some idea may be formed of the difficulties of the road, when, after more than two hours' hard walking, with little or nothing to carry, we had barely accomplished one mile. Shortly before noon a halt was called and the artificial horizon set up. Fortunately the sun was favourable to us, and we were able to obtain a good altitude as it passed the meridian, although almost immediately afterwards dark clouds rolled up, snow began to fall, and the sun was lost in obscurity. We found the latitude to be 83° 20′ 26″ N., or three-hundred and ninety-nine miles and a half from the North Pole."

The return journey was full of difficulties as by this time more of the men were suffering from scurvy. At length Markham found it necessary to send Lieutenant Parr ahead to obtain help from the ship. When the latter arrived at the "*Alert*" it was at once realised from the gravity of his expression that some calamity had occurred. His report that he had left his comrades 40 miles away, stricken with scurvy and almost helpless, while he made the lonely journey to obtain assistance for them, resulted in the immediate despatch of the ship's doctor followed by a strong party under Nares himself. Before relief arrived, however, one man died, and of the remainder 11 were so weak that it was necessary to bring them back to the ship on sledges.

Fears were now entertained for Aldrich and his party, who had not returned from the survey of the coast of Grant Land, and Lieutenant May was therefore despatched to find them. Scurvy had attacked this party also on the outward journey and the condition of most of the men had become so serious that Aldrich was about to follow Markham's example and send for help, when May fortunately came to their assistance. On Aldrich's return the total number of serious cases of scurvy on the "*Alert*" was increased to 40.

Meanwhile the crew of the "*Discovery*" were undergoing a somewhat similar experience. From their more southerly winter quarters various exploring parties were sent out and accomplished much valuable work. Prominent among these was a party under Lieutenant Beaumont that crossed Robeson Channel and explored the north of Greenland as far as Cape Britannia. Beaumont sent Lieutenant Rawson back while on the outward journey with instructions to bring out a relief party to meet him on his return. It was fortunate that he did so, for when Rawson and Hans with a dog team met the returning explorers on 25th June, Beaumont and two of his men were dragging the sledge with four helpless men lashed upon it. Scurvy had attacked them also and that day's journey would undoubtedly have been their last if help had not arrived.

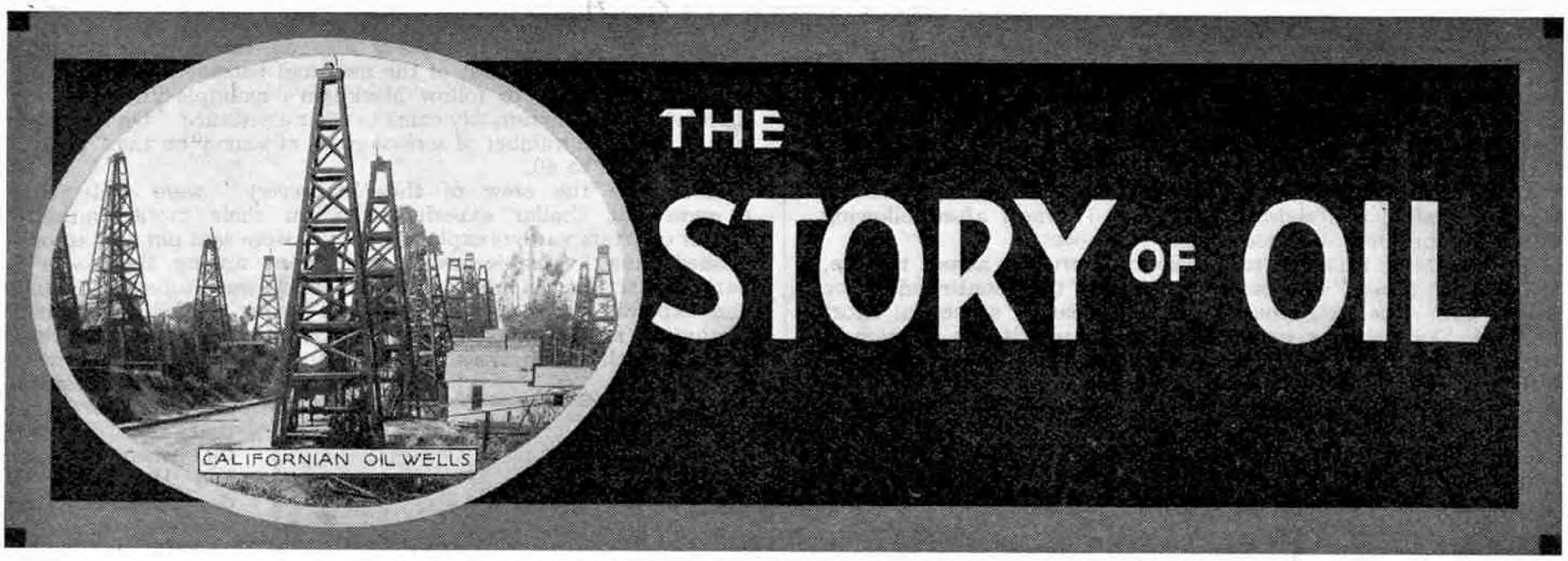
The parties had all reassembled and the return to the south was commenced on the last day of July. The journey proved extraordinarily dangerous, the ships being constantly under threat of destruction by icebergs or of being forced on shore by the pressure of the floes. Handled with great skill by the veteran Nares, however, both the "*Alert*" and the "*Discovery*" came safely through.

In spite of the ravages of scurvy the members of the expedition had shown themselves to be worthy successors of the great British explorers of the past and had added enormously to our knowledge of Polar conditions in addition to exploring large tracts of previously unknown country.

Five years later the work of the Nares expedition was continued by A. W. Greeley, an American explorer. Greeley was ostensibly taking part in a comprehensive scheme of polar research, in conjunction with parties of scientists of other nationalities stationed at various points within the Arctic circle, but he was also instructed to send out sledging parties "in the interests of exploration and discovery." In other words he was to make a dart for the Pole. On board the "*Proteus*" the expedition made its way north as far as the winter quarters of the "*Discovery*." The ship then returned south after landing a party who built a house on the shore, naming the place Fort Conger.

Excellent work was carried out in the summer of 1882. Greeley himself explored Grant Land. He travelled with a four-wheeled wagon christened the "man-killer" by the unfortunate beings who had the task of dragging it over the frozen wastes. It is not surprising to learn that it was quickly abandoned. An interesting find made on this journey was an Eskimo's house at Lake Hazen, West of Fort Conger. In the meantime Lockwood with twelve men extended Beaumont's survey of the north coast of Greenland and did not turn back until he had reached a spot on the coast that was a few miles nearer the Pole than Markham's farthest north.

Complete disaster almost overtook Greeley's expedition. The relief ships failed to reach Fort Conger in 1882 and 1883, one of them being crushed by the ice, the crew escaping south in small boats. When assistance did finally reach him in 1884, seven only of the expedition were discovered alive and these were in a desperate condition from hunger and disease. The seriousness of their plight may be gauged from the fact that one of their number had been shot for stealing sealskin thongs, the only remaining food.

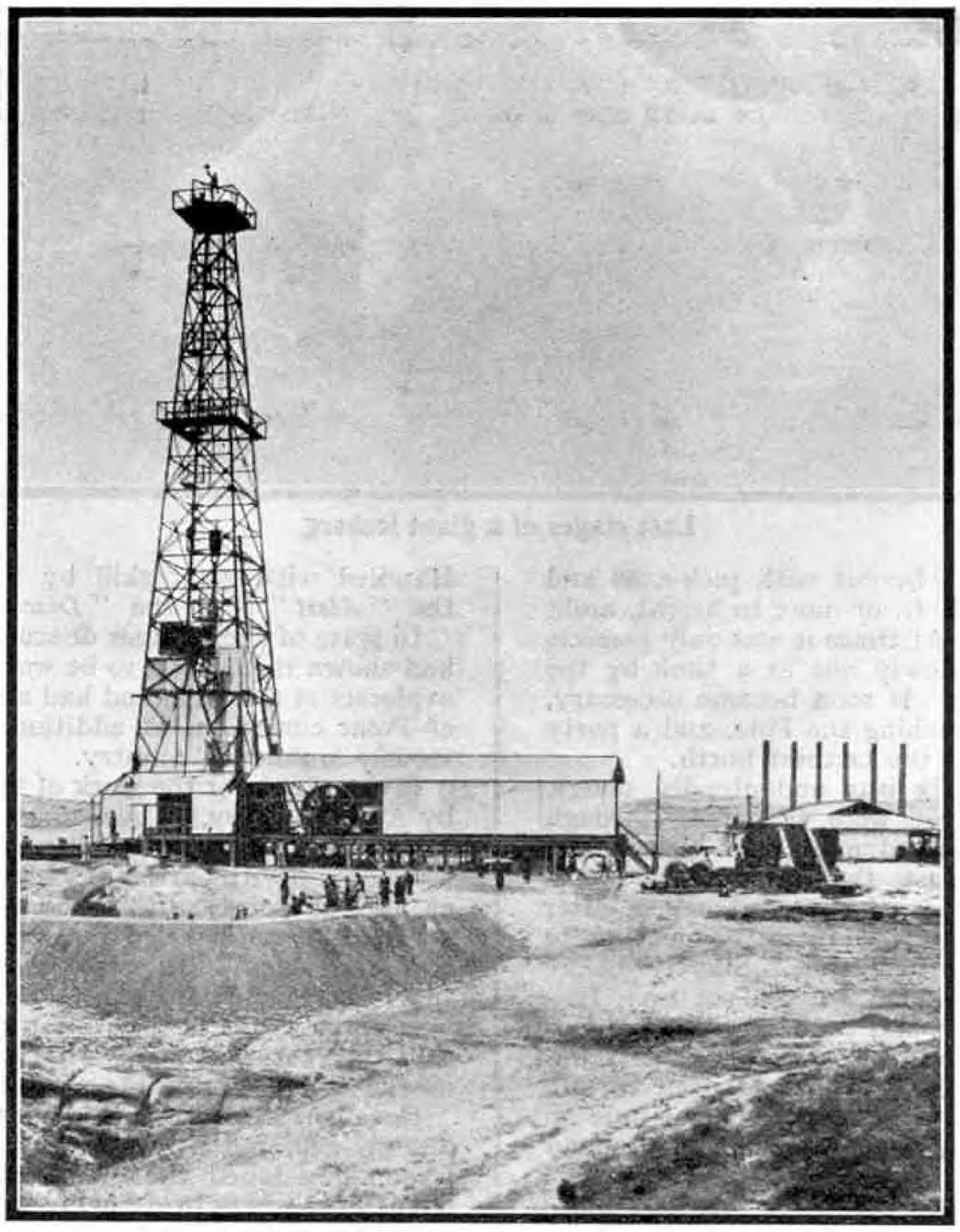


II.—ROMANCE OF THE PERSIAN FIELDS

AT the time when Lord Cowdray's engineers were investigating the extent of Mexico's hidden wealth of oil, as related last month, an English prospector named William Knox D'Arcy was likewise making history in Persia.

D'Arcy was born at Newton Abbot, Devonshire, in 1849, and he was 17 years of age when he accompanied his parents to Queensland, Australia. There his father established himself in the town of Roehampton in his profession of solicitor, and took his son into his office so that he might commence the study of law. The boy was destined to have a more romantic career, however, and one day Fate, in the guise of a client, took a hand. This client, whose name was Sandy Morgan, showed young D'Arcy a lump of rock and asked him what it was, remarking that " there's a whole mountain of it back of my place." D'Arcy recognised it immediately as gold quartz and promptly fell a victim to " gold fever." He and Morgan agreed to join forces, and this partnership was the beginning of the world-famous Mount Morgan Gold Mine. In a few years the two men, and others who were early associated with them, became millionaires.

The adventurous and profitable exploiting of gold deposits whetted D'Arcy's appetite for further fortune hunting, and he began to look about for new fields to conquer. At that time oil was just beginning to be appreciated as a valuable commercial product and D'Arcy was quick to realise the great possibilities of the industry. He was not long in making up his mind to win a share of the wealth awaiting those early in the field of exploitation.



Drilling operations in progress at No. 1 Well, Palkhana

A young Persian named Kitabji told D'Arcy of abundant surface deposits of oil in the north of Persia. The existence of oil in that country had been known for centuries, but the extent to which it was present had never been ascertained. Prospecting for oil was first carried out in Persia in 1872 by a man named Baron Julius de Reuter, but his enterprise did not achieve success. Subsequently many other fruitless efforts were made by prospectors to prove the extent of the Persian deposits. A company known as the Persian Mining Corporation was formed in the early ' 'nineties,' under the auspices of the Imperial Bank of Persia, which had obtained a concession for the entire mining rights of the country. The company commenced boring operations at Daliki, near Bushire, in the vicinity of a natural spring from the surface of which the natives of the locality skimmed petroleum. Two wells were sunk in this district, but the ultimate yield of oil proved so poor that the concession was finally abandoned by the disheartened company.

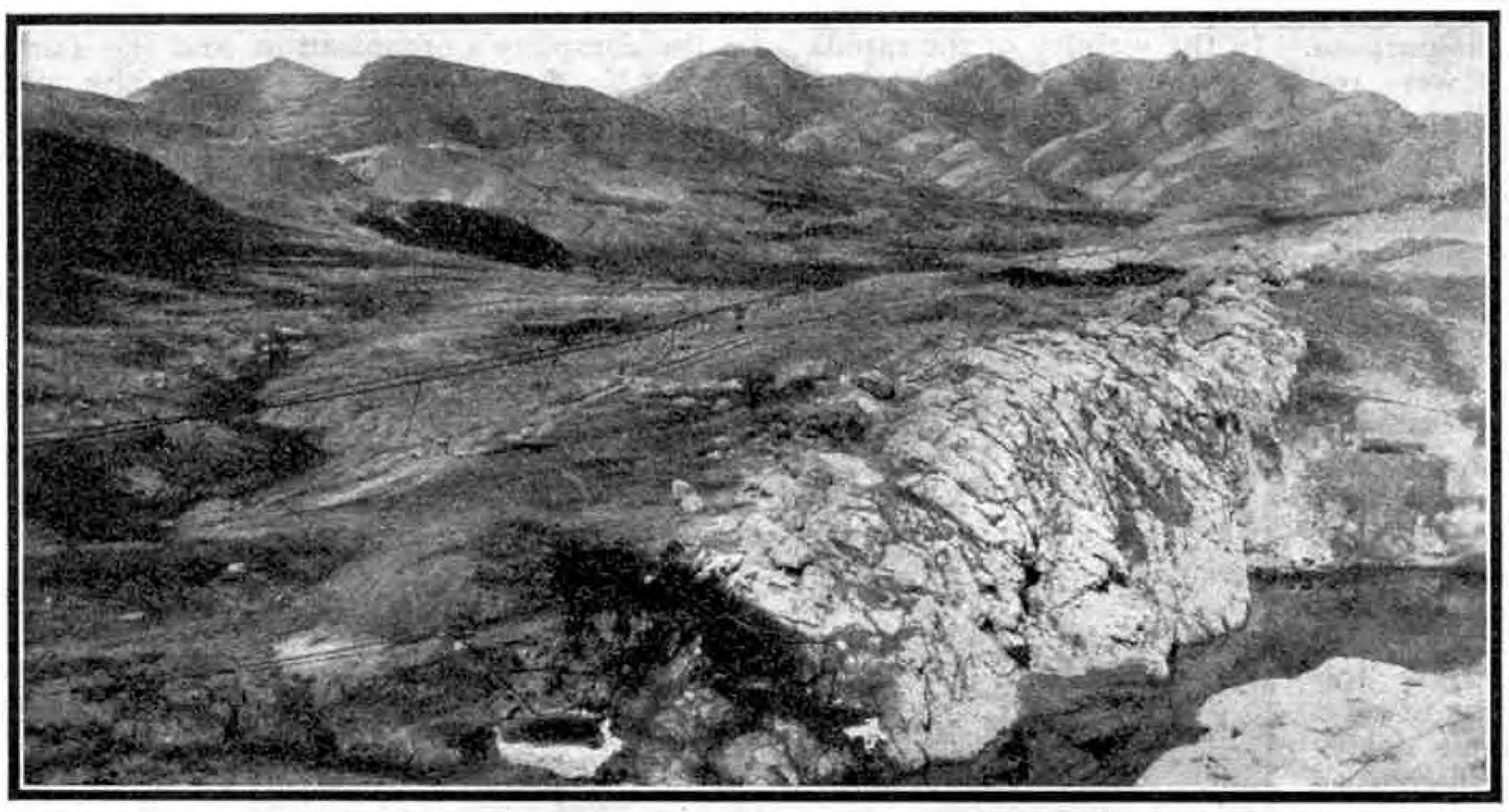
After studying various reports D'Arcy decided that the question of Persia's oil resources was worth further investigation, and accordingly he sent an experienced geologist named H. D. Burls to that country to carry out surveys. Burls made a careful examination of two areas, one north of Baghdad and near to the Turco-Persian frontiers, and the other in the Shustar district. He reported favourably on both, especially the former, where a primitive local oil industry had existed for many centuries and a steady and abundant output of oil was still being obtained. On receipt of these encouraging reports D'Arcy sought to obtain a concession from the Persian Government, and in 1901 the Shah granted him the exclusive right to exploit the natural gas, petroleum, ozokerite and asphalt throughout the Persian Empire, with the exception of five provinces along the Caspian Sea which, in this matter, were regarded as coming under Russian influence. This generous concession referred to 500,000 square miles of Persian territory and was valid for a term of 60 years.

A company, chiefly financed by D'Arcy, was then formed, and Chiah Sourk, about 100 miles north of Baghdad, was selected as the first place in which to search for oil. Boring operations commenced, and month by month the drills bit their way down into the earth, but by the close of the first year of operations the engineers were still without the welcome sight of oil oozing up out of the bore-hole. A second and a third year of fruitless toil followed, but D'Arcy was convinced that there were vast resources of oil if only they could be located, and he refused to be discouraged. In January, 1904, oil was struck in one of the borings, and in May of the same year the precious liquid commenced to flow from another well. Of these two wells one ultimately yielded a flow of nearly 600 barrels of oil per day. No further successes were achieved during that year and by the close of 1904 D'Arcy had expended more than £300,000

of his own money in the exploitation of the Chiah Sourk oilfield—a costly outlay in view of the meagre success achieved.

Chiah Sourk was about 600 miles from the Persian Gulf and the remoteness of the oilfield rendered its development difficult. It soon became apparent that if the work of the company were to be profitably carried on, oil must be located in some more accessible district and in considerably larger quantities. About this time D'Arcy was approached by a group of German financiers who proposed to purchase the Persian concession, but, confident that he would ultimately locate the wealth of oil he anticipated, he refused the offer.

In 1904 the question arose in this country as to whether the Royal Navy should adopt oil fuel in place of coal, and the Admiralty appointed a committee to investigate and report as to where adequate and regular supplies of oil could be obtained. The committee's report was in due course received, but the Government did not arrive at any definite decision and eventually the subject lapsed. The attention of the committee had been directed to the great importance of the Persian Oilfield, and their active interest in the latter was in part responsible for a syndicate being formed in Glasgow the same year, to take charge of the operations in Persia.

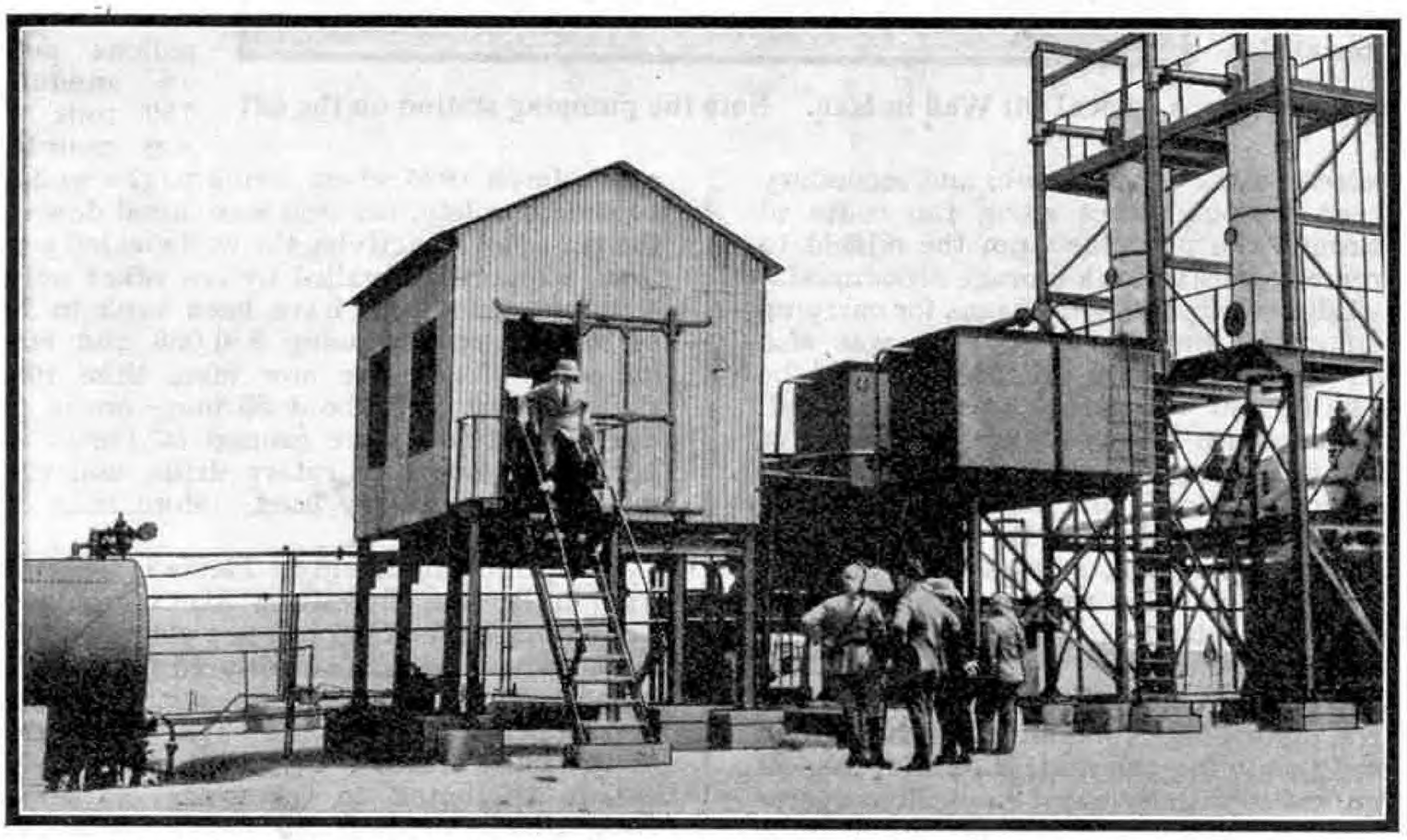


A portion of the Palkhana Oilfield in Iraq, showing rugged nature of the district in which boring operations are being carried on by the Turkish Petroleum Company

Under the new regime exploitation at Chiah Sourk was stopped and the wells were capped, except for such outflow as was necessary to enable a small refining plant for local uses to continue working. Boring operations were then transferred to Marmatain, close to Ahwaz, on the Karun River. The district presented no serious geographical obstacles, but the yield of oil obtained from the wells sunk there was so disappointing that eventually it was decided to seek success in some other locality.

This time the choice was the Baktiari Hills district, where numerous surface deposits of oil had been reported. Boring was there commenced in a desolate valley called Maidan-i-Naftun, meaning "Valley of Oil." On a hill overlooking this valley are the ruins of a temple known as "The Temple of Solomon," erected long ago by the Zoroastrians, or Fire Worshippers. Close by a mule track that led through the valley was a small natural oil spring, the flow from which passed into an adjoining stream that was impounded at that point by ancient dams. The natives of the locality skimmed the oil from the surface of the pool thus formed and sold it for burning purposes or for use as a medicament, while the bitumen deposited from the oil was utilised for caulking the crude native boats used on the Karun River.

The drilling plant at Marmatain was dismantled and conveyed by mules across the mountains to the new site. These journeys were as arduous as many that have been undertaken by fortune hunters in the great gold rushes. Not only was there a complete absence of railway facilities or motor transport, but such highways as existed were mere tracks made by the passage of countless mules and camels during many centuries. On the mountains the tracks were in places so narrow that it was difficult for the heavily burdened mules to negotiate them. A further trouble was that the natives of some of the districts through which the convoy passed were inclined to be hostile. The pioneer party numbered 12 Englishmen and six Canadian drillers, and it required considerable courage to commence erecting derricks in a neighbourhood inhabited solely by almost uncivilised tribes. In spite of all obstacles, however, boring operations were in due course commenced.



King Faisal descending the stairway after officially opening the Anglo-Persian Oil Company's Refinery at Alwand

The additional funds provided by the formation of the syndicate dwindled steadily as month by month the search for the precious oil continued without success. At the headquarters in Glasgow the prolonged absence of favourable news from Persia caused increasing anxiety. Conferences were held at which the situation was discussed, but the possibility that word might come any day that a big "strike" had been made caused drastic action to be deferred. By May, 1908, the situation had become critical, and it was then decided to terminate the operations at Maidan-i-Naftun. Instructions were then despatched from London to the company's engineers in Persia that boring was to cease and the plant was to be dismantled.

D'Arcy and his men had realised that the costly drilling operations could not be maintained indefinitely, and reports from Glasgow at length made it clear that unless oil was struck at an early date defeat would have to be accepted. Then, on 26th May, 1908, while the dreaded message was speeding toward them, the oil drillers achieved an eleventh hour victory. From one of the wells there came a dull roar, and suddenly a thick stream of black liquid shot high into the air, taking with it the drilling tools, and, by sheer force, wrecking the derrick.

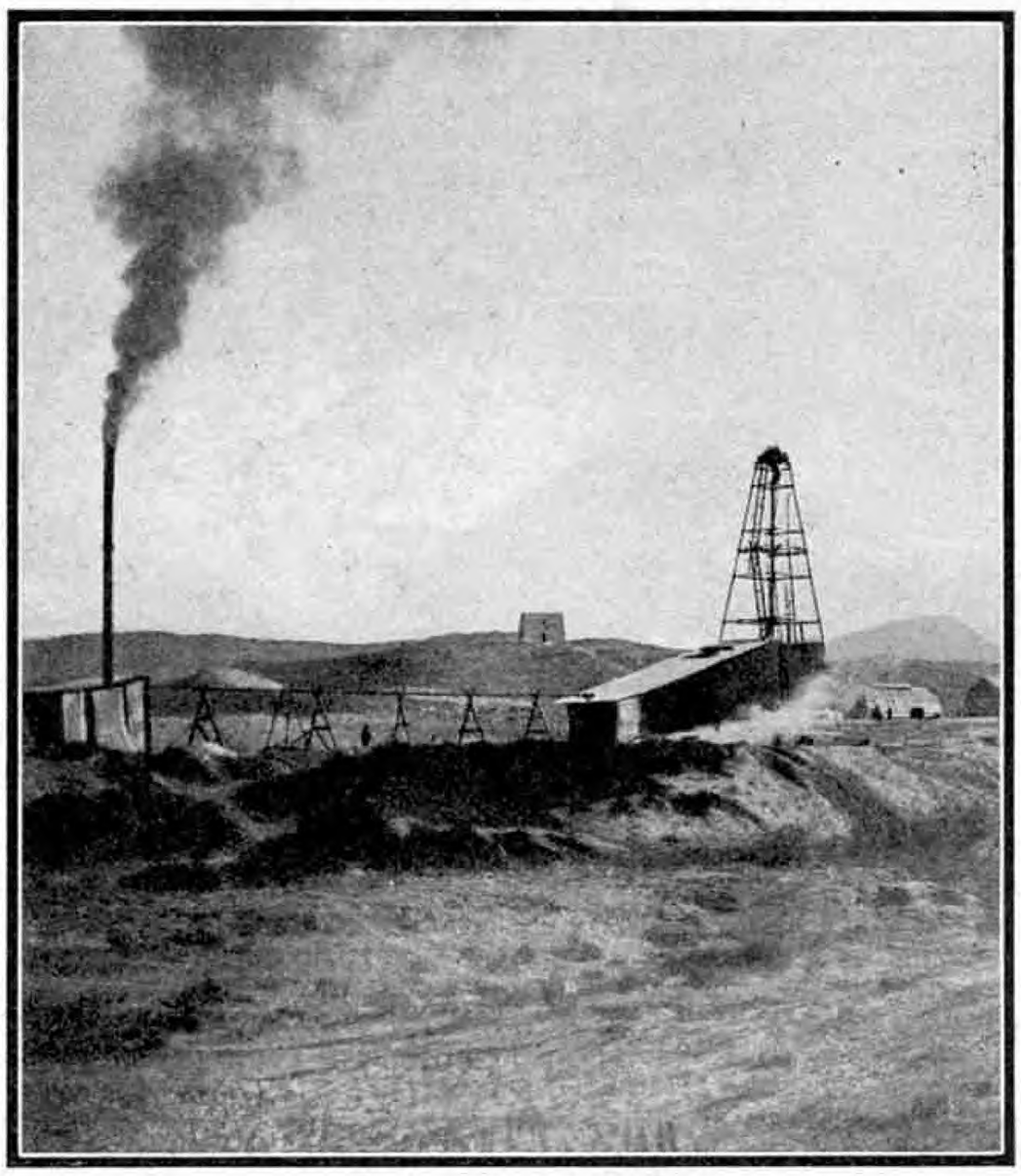
The drillers were wholly unprepared for such a spectacular arrival of the oil and they were completely drenched before they could get away from the site, while the pressure of gas released by the oil as it gushed forth almost suffocated them. The power of the "gusher" confirmed D'Arcy's belief that the region was undermined by a vast oilfield.

The well was got under control in due course and boring operations were then commenced in another part of the oilfield where, at a depth of 1,875 ft., the drill penetrated through the rock and an oil gusher of similar magnitude to the first was released. Adequate

supplies of oil were now available for exploitation and a company was formed in England under the name of the Anglo-Persian Oil Company, with a capital of £2,000,000, to take over and develop the Persian oilfield.

With the great wells carefully capped the engineers turned their attention to establishing improved means of communication with the oilfield. The Karun River was utilised in part for the conveyance of plant, shallow draught launches and steamers being placed on the river for this purpose. In the vicinity of the rapids at Ahwaz the materials were removed from the launches and conveyed by means of a specially constructed short railway to the river at Der-i-Khazineh, above the rapids. From Der-i-Khazineh the materials were carried by mules to the oilfield 30 miles distant, by way of a narrow road excavated by the engineers, up the valley of the River Tembi.

The route selected for laying the pipe-line from the Persian coast to the oilfield was roughly 145 miles in length and traversed two mountain ranges, and the construction of a narrow road over the mountains to facilitate the transporting of the lengths of pipe was put in hand without delay. The explosion of dynamite charges echoed amid the silent hills as the rock was blasted away and a mule track, wide enough to accommodate two mules abreast, was made. A small refinery for treating the oil was erected on the Island of Abadan and from there the pipe-line was led across the Persian plain of Ispahan, where the passage through the mountains commenced. Each length of pipe weighed 820 lb. and was slung between four mules, two on each side of the pipe. In this manner the material for the pipe-line from Ispahan to the oilfield was transported to the site.



A typical Oil Well in Iraq. Note the pumping station on the left

A power station was erected on the River Tembi and secondary power houses were built at various places along the route to aid in pumping the oil through the pipe-line from the oilfield to the refinery at Abadan, where extensive tank storage accommodation was prepared. A workshop equipped with means for carrying out engineering repairs of every kind likely to arise was also constructed there. Jetties alongside which oil tankers could be berthed for loading were built, and a dry-dock was constructed.

Living quarters to accommodate a large number of native employees were built, and the company provided also a well-equipped hospital, a telephone service, and a wireless station, while electric light was installed throughout. By October, 1912, the pipe-line and plant were in operation, and the first delivery of refined spirit was made from Abadan in the same year. Eventually the output of the refinery attained 6,000,000 gallons per month.

The extensive laying-out of plant and the establishing of the colony almost exhausted the funds of the company, and the British Government, who were still pondering the matter of adopting oil fuel for the Navy, were approached with a view of financial co-operation. A Royal Commission was set up in 1912 to revise the work of the 1904 committee. Various authorities were consulted, among whom was Sir Charles Greenway, at that time managing director of the Anglo-Persian Oil Company. He gave a most favourable account of the great possibilities of development that existed in the Persian oilfields, and as a result the First Lord of the Admiralty then despatched an independent Commission to Persia to verify the declaration that had been made. On their return the Commission fully confirmed the evidence previously put forward, and in 1914 an agreement was made between the Anglo-Persian Oil Company and the Government by which the latter acquired a controlling interest in the company.

The Great War created a tremendous demand for oil fuel and the facilities available in Persia were made full use of by the Government. New wells were sunk, the refinery at Abadan was considerably developed, additional and larger pipe-lines were laid, and more oil tankers were constructed. Naturally the increased activity at the oilfield and Abadan attracted the attention of the enemy powers and soon after war commenced the Turks began to take an unwelcome interest in the affairs of the company. An attempt was made to render Abadan inaccessible by sea by laying mines some distance from the coast, but the scheme was detected and eventually dealt with by the Indian Expeditionary Force, who were also instrumental in preventing an intended bombardment of the refinery.

Some time later another attempt was made to interfere with the company's organisation, and the Turks, having coerced some of the natives to assist them, succeeded in cutting the pipe-line above Ahwaz, thereby causing the oil flowing through the line to escape. This was qiuckly discovered by the nearest pumping station and steps were immediately taken to stop the flow. Oil worth some £144,000 was lost, however, and the operation of the pipe-line prevented for several months. While the attack on the pipe-line was in progress the Turks attempted to invade the company's settlement at Abadan but the small British force stationed there eventually dispersed them.

The development of the Persian oil-field included the sinking of a large number of wells, and one of these, known as the F.7 well, became world-famous on account of its remarkable productivity. Drilling for this well was commenced in August 1911, and oil was tapped in November the same year. The engineers restricted the flow to 1,000 gallons per day, but one day during March 1914 the force of the upward flowing stream suddenly increased and, overcoming all obstacles, the crude oil gushed forth at the rate of about 525,000 gallons per day, equivalent to an annual output of roughly 750 tons. This abundant flow was maintained year after year until March 1926 when, owing to the well-head equipment having become obsolete, the well was closed down permanently. During the period of its activity the well yielded a total of almost 7,000,000 tons, a quantity rivalled by few other wells.

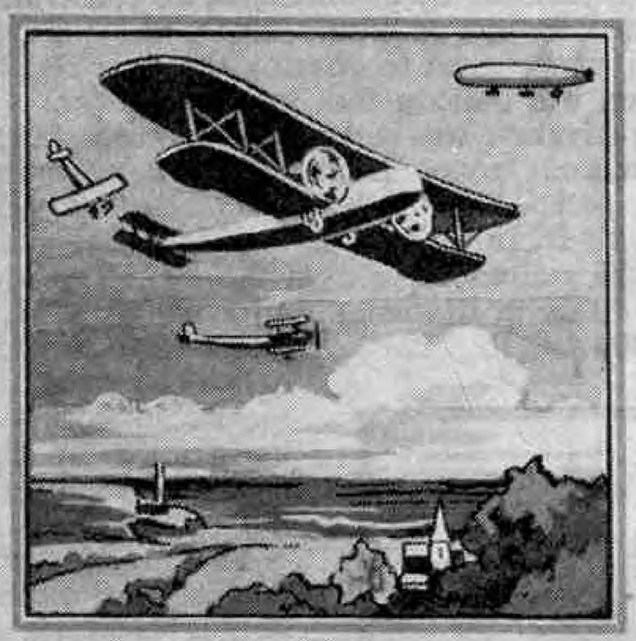
Many other wells have been sunk in Persia since 1911, some of which are producing 550,000 and 600,000 gallons of crude oil daily. There are now more than 100 wells in operation in that country, and about 50 more are in process of being drilled. The formation of the ground in Persia is rather unsuitable for boring by means of rotary drills, and therefore percussion type machines are mostly used. More than 50 of these are now in service.

The principal oilfield in Persia is situated in a series of narrow, irregularly shaped valleys averaging 30 miles in length. The full extent of the field has not yet been ascertained, but test wells have proved an area roughly 15 miles in length and five miles in breadth at the widest part, without discovering any indication of the field thinning out. The steadiness of the outflow is one of the chief features of the Persian oil wells, and is to a large extent attributed to the crude oil being contained in porous rock, which yields it up with greater steadiness and regularity than does oil-sand.

At Abadan, the coastal terminus of the pipe-lines from the oilfield, there are over 100 storage tanks, some for the crude oil from the wells and others for refined spirit, while numerous jetties projecting toward midstream accommodate the ocean-going tankers into which the oil is loaded for export to England and elsewhere. Some idea of the extent of the oil industry in Persia may be gained from the fact that more than 30,000 people are employed there by the Anglo-Persian Oil Company. This number includes about 700 Europeans and nearly 5,000 Indians, the remainder being Persian subjects.

The oilfield has been proved to extend into Iraq and Turkey, and systematic exploitation is being carried on in both these countries by the Turkish Petroleum Company. One of the most important centres of operation is at Palkhana in Iraq. The plant at this oilfield is thoroughly up to date as may be seen from the illustration on page 202.

(To be continued)



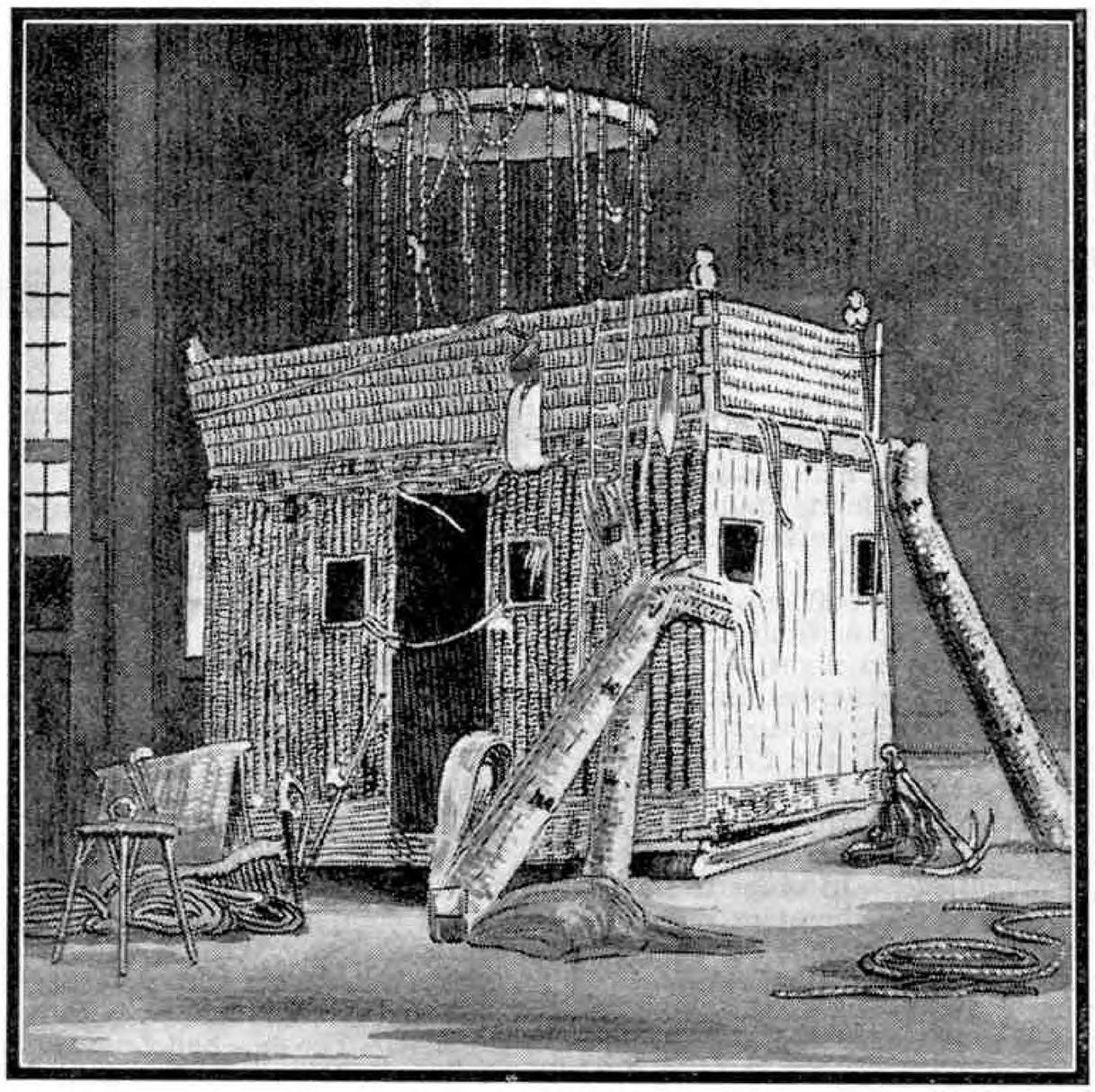
The Conquest of the Air

EARLY BALLOON ASCENTS

THE first 50 years during which ballooning was practised had enabled aeronauts to demonstrate that, given normal weather conditions, balloon flights could be regarded as reasonably safe. At the same time, the balloon was entirely at the mercy of the wind, and the aeronaut had no means of directing his flight in any given direction. It was obvious that ballooning could never become of any practical value until some means could be found of steering a course irrespective of the direction of the wind, and aeronauts and scientists began to give serious attention to the problem of devising a dirigible balloon.

A French mathematician, Gaspard Monge, proposed in 1783 an ingenious method of directing the flight of balloons. His scheme was to attach 25 spherical balloons together after the fashion of beads on a necklace. The connections between the balloons were to be sufficiently flexible to allow the series to travel through the air either in a straight line or in erratic formation, according to the air currents encountered.

The car of each balloon was to accommodate two aeronauts to whom instructions in regard to ascending or descending would be conveyed by means of signals by the captain, who presumably was to be in the car of the first balloon. Apparently, Monge had the idea that this arrangement of balloons would wriggle its way through the air in a similar manner to a snake wriggling through water ! This curious scheme was never tried out, which is rather a pity, for the results must have been decidedly interesting !



The peculiar Car of Nadar's Balloon

Another Frenchman, Guyton de Morveau, who gave considerable attention to this subject, conceived the idea that the spherical balloon was wrong on account of the resistance it offered to the atmosphere. He put forward a suggestion that a balloon should be constructed with its front shaped like a wedge, and with steering gear in the rear in the form of a hoisted vertical sail. This idea was ingenious, but in practice the steering arrangement proved a failure. Some time later, General Meusnier, a distinguished officer in the French Army and a man of considerable scientific and technical knowledge, turned his attention to the problem of rendering balloons navigable. He came to the conclusion that the large surfaces presented to the atmosphere by spherical balloons rendered them wholly unsuitable for navigation purposes, and recommended that balloons should be elliptical in shape. He also suggested, as a further aid to reducing surface resistance, that the balloon cars should be boat-shaped, and fitted to the balloon so that they pointed in the direction of motion.

Meusnier designed an elliptical balloon in which he instituted the use of rigid connections to link up the balloon envelope and car, while midway between the two he arranged three vertical propellers operated by hand, by means of pulleys. By means of these propellers, the blades of which as they rotated could be contracted or expanded at will by the operators, Meusnier anticipated that a speed of three miles an hour could be obtained. The propellers were intended also to enable the balloon to be moved from one current of air to another more favourable, thus escaping from adverse atmospheric conditions. He calculated that a crew of 80 men would be necessary to work the propellers speedily enough for them to be really effective !

The most important improvement in balloon construction introduced by Meusnier was a method of partially inflating or deflating a balloon while in flight, without use of valves or ballast. The innovation involved the use of two balloon envelopes, one inside the other. The inner bag was to be held in place by ropes and inflated with gas, while the space between this bag and the outer cover was to be filled with air, injected by means of hand-operated bellows situated in the balloon car. The balloon envelope was to have a thick additional outer covering held down by rope network secured by its ends to the car.

Meusnier also designed an anchor somewhat resembling a harpoon which, when thrown overboard to earth, could be relied upon to effectively bury itself in the ground.

Although Meusnier never constructed a balloon according to his design, probably finding the proposition too costly, his inventive genius was greatly respected. It is recorded that when he was killed in 1793, while fighting against the Prussians at Mayence, the King of Prussia on learning the sad news, immediately ordered a cessation of firing until the body of the famous officer had been buried.

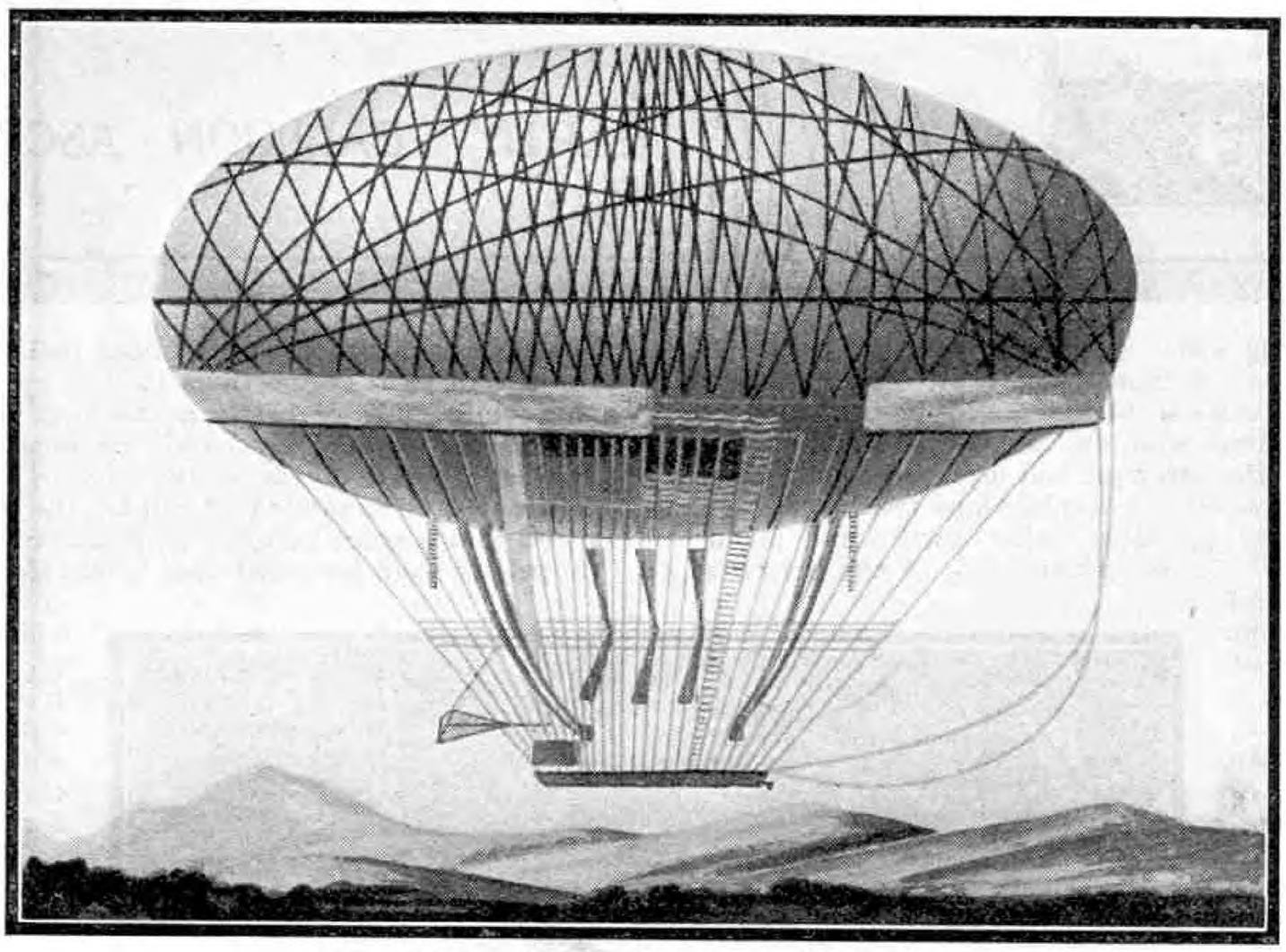
An adaptation of Meusnier's theory was tried out later by the brothers Robert, whose pioneer exploits in ballooning were related in the "*M.M.*" of December last. The aeronauts fitted inside the envelope of one of their balloons a bag filled with air, while the space intervening between the bag and the outer envelope was filled with gas—the reverse of Meusnier's method. The air-bag was fixed close to the opening provided in the balloon envelope for the escape of excess gas. The balloon car was equipped with oars and rudder.

An ascent was made with the Duke of Chartres in the car as a passenger. After rising steadily for some time the balloon entered

a violent eddy. So great was the rush of air that the rudders and oars were wrenched away and disappeared, while the ropes holding the air-bag in place inside the envelope snapped, causing the bag to settle over the aperture and effectively cut off the way of escape for the excess gas. As the balloon climbed upward to 16,000 ft., the imprisoned gas steadily expanded, and the balloon was almost on the point of bursting when the Duke had an inspiration. Drawing his sword he cut a short slit in the outer envelope, and as the pent-up gas rushed out, the balloon commenced to sink rapidly. By careful regulation of ballast the aeronauts effectually slowed down its descent and made a safe landing.

The air-bag experiment of the brothers Robert did not succeed in arousing much interest, and more than 50 years passed before any further practical endeavours were made to perfect a balloon that could be navigated through the air.

In 1834 an ex-colonel of the French Army, named Lennox, constructed a balloon having a cylindrical body with cone-shaped ends. It was 150 ft. in length and approximately 45 ft. in diameter. The envelope was made of silk specially constructed to enable it to retain hydrogen for a fortnight after inflation. Sixteen persons could be accommodated in the car, which was equipped with two pairs of oars on each side and a rudder at each end. The novel appearance of the balloon attracted a vast crowd to the Champ de Mars on the day fixed for the first ascent, but the balloon failed to rise. After waiting a long time in vain the crowd became exasperated and, rushing to the balloon, tore it to pieces, while its unfortunate inventor was also roughly handled. After this experience, Lennox retired from balloon experiments.



The Balloon designed by General Meusnier

The fact that no reliable method of navigating balloons had been found did not deter the famous aeronaut Green from declaring himself, in 1840, prepared to attempt a balloon flight across the Atlantic Ocean, provided some wealthy and generous enthusiast of ballooning would come forward and finance the venture. Green stated, in an article to the Press, that on all of the 275 balloon voyages that he had accomplished up to that time, he had found that "at a certain elevation, varying occasionally, but always within 10,000 ft. of the earth, a current from the west, or rather from the north of west, invariably prevailed." In order to have the advantage of this definite air-current he therefore decided that his proposed Atlantic flight should be from America to England. The necessary funds were not forthcoming, however, and in consequence the flight did not take place.

Three years later the idea of such a trip was revived by an American named Wise, who proposed to carry out a balloon flight during the summer of 1844, from New York to London. He published in the American Press a notice addressed to those of "the seafaring community of all climes" who had never seen a balloon before, and he briefly described such a sight. He requested them not to be afraid if they saw a balloon descend into the sea, but to approach it and render such assistance as they could.

Wise's balloon was designed to be 100 ft. in diameter and, as a protection against a forced descent while over the ocean, was to be fitted with a boat instead of the orthodox type of balloon car. It was calculated that the balloon would have an ascending power of 20,000 lb., and in addition to carrying the aeronaut it was to accommodate "a sea-navigator and a scientific landsman." Wise applied to the American Government for funds to enable him to carry out his project, but they regarded it as too impracticable and dismissed it. Nothing more was heard of the scheme.

In 1851 Giffard, another Frenchman, constructed a small steam engine of 5 h.p. and weighing only 100 lb. It then occurred to him that an engine of such lightness and modest dimensions might be used to supply motive power to a balloon. He decided to attempt the feat and, assisted by two friends, he constructed a navigable balloon shaped somewhat like a cigar, and pointed at both ends. This design was chosen as offering the least resistance to the atmosphere when the balloon was in motion.

The upper half of the envelope was covered in network, and from this passed down numerous ropes from which was suspended horizontally a heavy pole. This pole, which Giffard termed the airship's keel, was 66 ft. in length, and attached to one end was a triangular vertical sail to serve as a rudder. The airship was 144 ft. in length, 40 ft. in diameter at its widest part, and had a capacity of 88,000 cu. ft. The car was hung about 20 ft. below the envelope by means of ropes, and housed a 3 h.p. motor weighing 3 cwt., and a small boiler.

As a protection against the explosion of gas escaping from the balloon, Giffard fitted in front of the stokehole a piece of wire gauze, similar to that adopted for safety lamps, while gases escaping from the boiler were led away from the direction of the balloon envelope by means of a chimney that conducted them to one corner of the car and discharged them overboard in a downward direction. The steam blast provided the draught required to effect the ejection of the gases. The motor was capable of 110 revolutions per minute and rotated a propeller 11 ft. in diam., the three blades of which resembled the sails of a windmill. A rudder was also provided. The weight of the balloon with the aeronaut aboard totalled 1½ tons.

Giffard's boldness in introducing steam power in close proximity to the envelope containing coal gas caused considerable comment among both scientists and aeronauts, who awaited with interest the first flight of the balloon. This important event took place on 24th September, 1852, from the Hippodrome, Paris. The balloon rose to a height of 6,000 ft. and in spite of a strong adverse wind succeeded in travelling at a speed of almost six m.p.h. At dusk the enterprising aeronaut descended safely in a field at Elancourt.

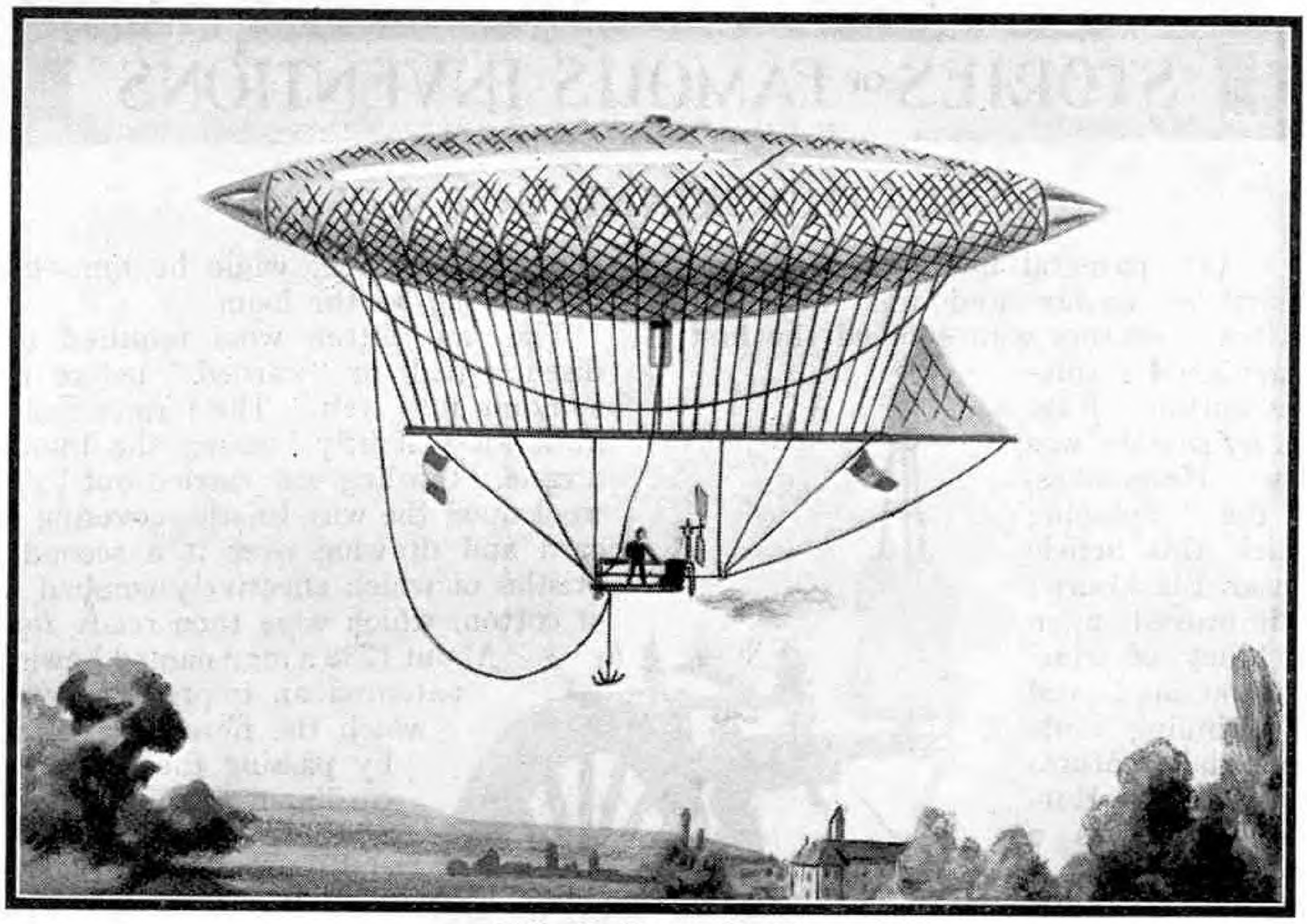
The steam-navigated balloon was a definite improvement upon the hand-operated oars and wings instituted by earlier aeronauts and was the first effective airship invented. Continued experiments convinced Giffard that much remained to be accomplished before complete control of a balloon while in the air could be demonstrated. With a view to further reducing the amount of surface resistance and thus obtaining increased speed of travel, he built another balloon considerably longer and narrower than the first. The new balloon was 230 ft. in length and 33 ft. in diam. at the middle, while the upper part of the envelope was stiffened by means of a special covering to which the network was attached, and the car was suspended below by ropes fastened to the four corners. The steam engine was removed from the first balloon and installed in the new one.

At the trial flight Giffard was accompanied in the car by one passenger. After ascending to the desired height the balloon was directed against the wind and it succeeded in making slow progress. When descending to earth it by some means lost its equilibrium, however. The weight of the car became unequally distributed, causing the network to break away, and the balloon collapsed and became a complete wreck. Fortunately the aeronaut and his passenger escaped with only slight injuries.

Giffard subsequently designed a balloon that was to be 1,970 ft. in length, 98 ft. in diam. at the middle, and of 7,800,000 cu. ft. capacity. The machinery was to be of massive proportions and it was calculated that the motor alone would weigh 30 tons. He anticipated that the balloon would be capable of attaining a speed of 45 m.p.h., but this costly scheme never materialised.

During the period of his active interest in aerostatics Giffard constructed two large captive balloons which were used at important exhibitions, where they reaped a substantial revenue for their respective owners by providing visitors to the exhibition with the thrill of a balloon 'ascent.' The first of these balloons was made in 1868 at a cost of almost £30,000 and was of 424,000 cu. ft. capacity. It was used in London. The other was constructed in Paris ten years later and had a capacity of 883,000 cu. ft. In his later years Giffard became blind and his death took place in 1882.

The belief held by Giffard that balloons could be rendered navigable was not shared by all aeronauts. Of his critics probably the most severe was a Parisian photographer named Nadar, who openly scoffed at the idea that any balloon could be navigated and controlled during its passage through the air. In the course of one of his characteristic denunciations of aerostats in general Nadar wrote: — "that which for the last 60 years has prevented the possibility of directing the course of balloons is the balloon itself. In other terms, it is sheer folly to endeavour to struggle against the air, when one is lighter than that air. . . . It is all very well to adjust and adopt all the various systems, however ingenious they may be—riggings, paddles, wings, fins, wheels, rudders, oars, helms, sails, and countersails—but they will never be able to prevent the wind from sweeping away the whole concern. . ."



Giffard's Steam Airship

Nadar believed that aerial travel could be achieved by means of a "heavier than air" contrivance driven by a screw which, in rotating, operated a number of large propellers. "It is the screw," he often declared, "which is to carry us through the air—it is the screw which penetrates the air as a gimlet does wood . . ." His aeromotive, or screw airship, which he believed would eventually supersede all balloons, was evolved upon the principle of a flying toy called a "spiralifer." A spiralifer, Nadar explained, "consists of four small flat fans, or rather spirals of paper, edged with wire, and attached at equal distances to a central spindle of light wood. This spindle is inserted into a hollow tube with a rotary movement, upon an immovable axle, which is held by the left hand. A string passed round the spindle and quickly pulled by the right hand imparts to it a rotary movement sufficient to enable this miniature screw to detach itself and rise several yards high in the air, whence it descends so soon as the force imparted to it has exhausted itself."

In order to obtain the necessary funds to construct his strange invention Nadar built a monster balloon with which he proposed to give exhibitions and flights at many of the European capitals. This balloon was a very remarkable affair. It consisted of two great envelopes one within the other, in the making of which 22,000 yards of finest quality silk was used. Each envelope comprised 118 gores each 147½ ft. in length, while the whole was entirely hand-sewn with a double seam. The most striking feature of all was the car. This was a two-storey structure of wicker-work, "traversed beneath and on its walls by 20 cables, interlacing their fabric, which were attached to the hoop." The roof was flat and was bordered by a wicker-work fence and was intended to serve the purpose of a promenade deck for passengers.

"It is carried upon two axles and four wheels," relates Nadar, "which are fitted on after descent, which gives it every facility of returning, supposing a descent far from the centres of population. Canes disposed to act as springs are placed underneath and round the middle to protect the car from concussions. Besides having buoys, an immense girdle, in compartments of inflated india-rubber, defends against every possible immersion. The ground floor contains a cruciform passage and six divisions." At one end was a bedroom for the captain and underneath a compartment for luggage, while at the other end of the cabin was a large compartment for passengers, containing three bunks one above the other. The remaining four compartments accommodated provisions, a photographic room and a lithographic printing press. It was intended with the press to print brief accounts of the expedition as this progressed, and distribute these over localities traversed by the balloon. The balloon was expected to be able to lift a total weight of 4½ tons, and its trial was awaited with great interest.

The first ascent was planned for 4th October, 1863, from the Champ de Mars, where a crowd of about 100,000 people assembled to witness the great event. While being inflated with hydrogen gas the balloon was held down by about 100 men and the weight of 200 sandbags. When the massive envelope was full the balloon towered to a height of 183 ft., only 14 yards less than the height of Notre Dame.

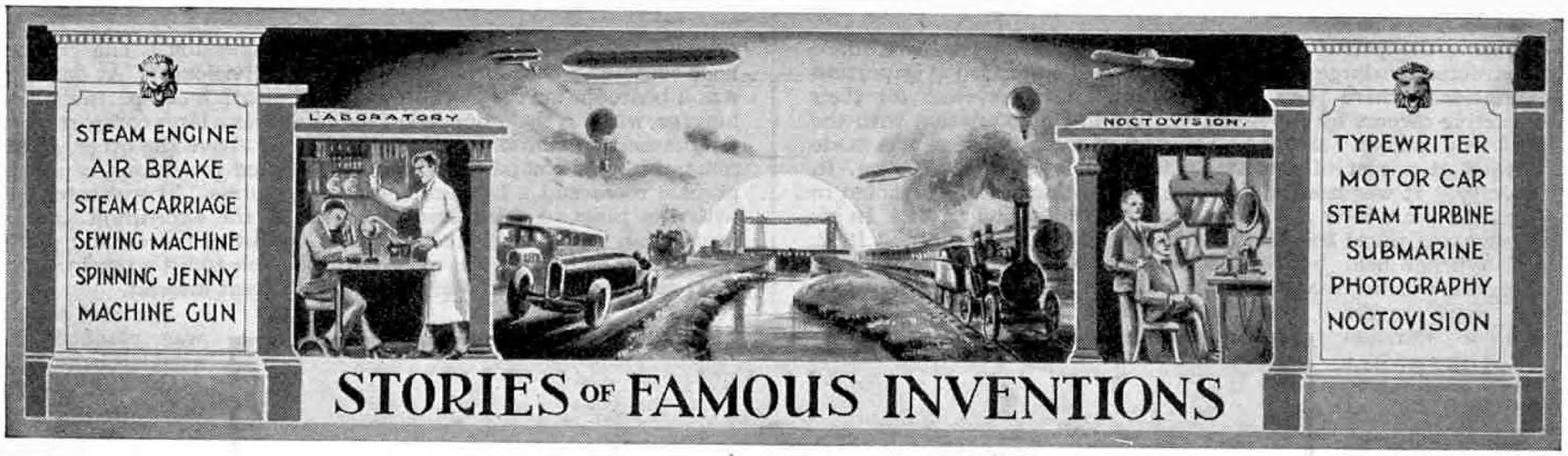
Nadar and his 14 guests, among whom were a prince and a princess, then entered the car and the balloon was released and ascended gracefully. After a voyage lasting five hours the balloon descended at Borcy, near Meaux. The descent was somewhat violent, and owing to the first grapnel thrown out breaking, the car was dragged on its side for a considerable distance before the second grapnel could be thrown overboard and the bumping balloon brought to a stand. One of the passengers received an injury to the knee and several others suffered from shock.

The second ascent in the "Giant," as the balloon had been named, was made from the Champ de Mars on Sunday the 18th October, the same year, and was witnessed by the Emperor of France, the King of Greece and a large crowd of people. On this occasion Nadar took up eight passengers, including his wife. As on the previous trip a large supply of provisions was taken in anticipation of a long voyage. The balloon ascended at 5 o'clock in the evening and soon disappeared in a north-easterly direction. During the night it traversed Belgium and at breakfast-time next morning was over northern Holland. It then encountered a violent westerly gale which carried it towards Germany. An attempt was made to land, but so great was the pull of the balloon that the heavy iron anchors broke away as if they were toys. For several hours the balloon was entirely at the mercy of the storm, and bounded across country at a terrific speed.

A reporter of the French newspaper "*La Nation*" afterwards vividly described the terrible experience of the balloon party. "The valve was shut," he said, "and the balloon, which would carry us no longer, began a giddy career. We rose from 20 to 30 metres, and fell with incredible force. Little by little the balloon ceased to rise, and the car fell upon its side. Then began a furious, disordered race; all disappeared before us—trees, thickets, walls, all broken or burst through by the shock; it was frightful. Sometimes it was a lake, in which we plunged; then a bog, the thick mud of which entered our mouths and our eyes. It was maddening. 'Stop! stop!' we shouted, enraged with the monster who was dragging us along. A railway was before us—a train passing; it stopped at our cries, but we carried away the telegraphic posts and wire."

"An instant afterwards we perceived in the distance a red house —I see it now,—the wind bore us straight for this house. It was death for us all, for we should be dashed to pieces. No one spoke. Strange to say, of those nine persons,

(*Continued on page* 238)



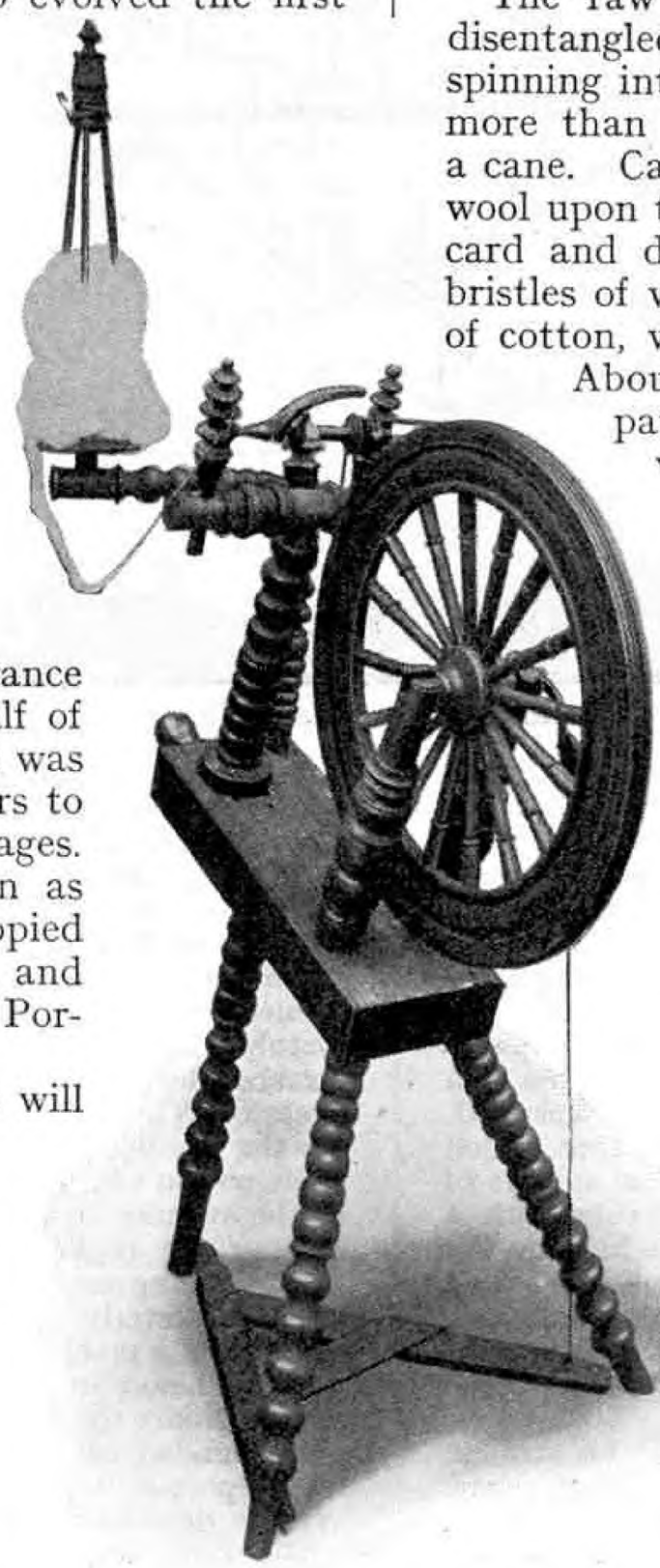
II.—THE SPINNING JENNY

LANCASHIRE is the parental home of the great cotton industry of to-day and was also the home of the four inventors who evolved the first really practical machines for spinning and weaving cotton. Kay, the inventor of the fly shuttle, was a native of Bury; Hargreaves, the inventor of the "Spinning Jenny," with which this article deals, was born near Blackburn; Arkwright, who improved upon the spinning machines of Hargreaves was a Preston man, and Crompton, whose spinning mule combined the essential features of the inventions of both Hargreaves and Arkwright, was a native of Bolton.

These inventions made their appearance at various times during the latter half of the 18th century. Up to that time it was the practice of the Lancashire weavers to weave their cloth in their own cottages. The material they made was known as "calico" from the fact that it was copied from Indian goods woven at Calicut, and first introduced into Europe by the Portuguese.

If a piece of calico is examined it will be seen that it consists of threads that cross one another. The longitudinal threads are known as "warp" and the shorter cross threads are known as "weft." In the calico woven in the Lancashire cottages cotton was used for the weft, but linen was adopted for the warp as up to that time no method had been discovered of spinning cotton fibres into a thread of sufficient strength for the purpose.

The manufacturers called regularly upon cottagers in the villages of their district and sold to them raw cotton wool for spinning into weft thread and linen yarn to be used as warp for the weaving. In return the manufacturers purchased the calico that the cottagers had woven since the previous visit. In some towns weekly markets were afterwards established, to which the cottagers took their finished cloth for sale and returned home with fresh purchases of linen yarn and raw cotton. The carding and spinning operations were usually carried out by the cottager's wife and children, while he himself devoted his time to weaving on the loom.



An Early Spinning Wheel

The raw cotton wool required to be cleaned and disentangled, or "carded," before it was suitable for spinning into weft. The former task consisted of little more than lightly beating the bundle of cotton with a cane. Carding was carried out by placing the cotton wool upon the wire bristles covering one side of a stout card and drawing over it a second similar card, the bristles of which effectively combed out the thin fibres of cotton, which were then ready for spinning.

About 1738 a man named Lewis Paul invented and patented an improved method of carding, in which the fibres of cotton were attenuated by passing them between rollers. Paul's carding machine did not find ready favour, however, and it was not until about 1760, eight years after the patent had lapsed, that the invention was introduced into Lancashire, one of the machines being then erected in the Wigan district by a man named Morris. Shortly afterwards a cotton manufacturer at Blackburn, Robert Peel, grandfather of Sir Robert Peel, the famous statesman, commenced experiments with a view to improving upon Paul's method, and employed a local weaver named James Hargreaves to assist him.

James Hargreaves was born about 1745 at Standhill Moor, near Blackburn, where his parents eked out a meagre livelihood by spinning cotton and weaving calico in their own cottage. They were unable to afford the boy a school education, but he was taught the trade of his parents as soon as he was old enough to understand it. It is said that he also acquired some knowledge of carpentry and occasionally added to the family income by this means. Later he went to Peel's mill at Blackburn and while assisting his employer in experiments with carding machines he successfully adapted to cotton the carding system employed in the manufacture of woollens. In his arrangement one card was held in a fixed position while the other was suspended over a pulley by means of a cord, to the other end of which was attached a weight to balance it. The task of the operator, or carder, then consisted of moving the corded card to and fro over the cotton wool on the fixed

card. This arrangement enabled the operator to manipulate two or three corded cards to the same fixed card.

At a later date Peel effected further improvements in the method of carding cotton in preparation for spinning. The principle remained the same, but the fixed card was replaced by a cylinder covered with similar small wiry teeth. This cylinder was made to revolve while a flat card, moving vertically, came into contact with it when passing. By this method the cotton wool was combed out more effectively and speedily. The innovation was first installed in Peel's mill at Brookside.

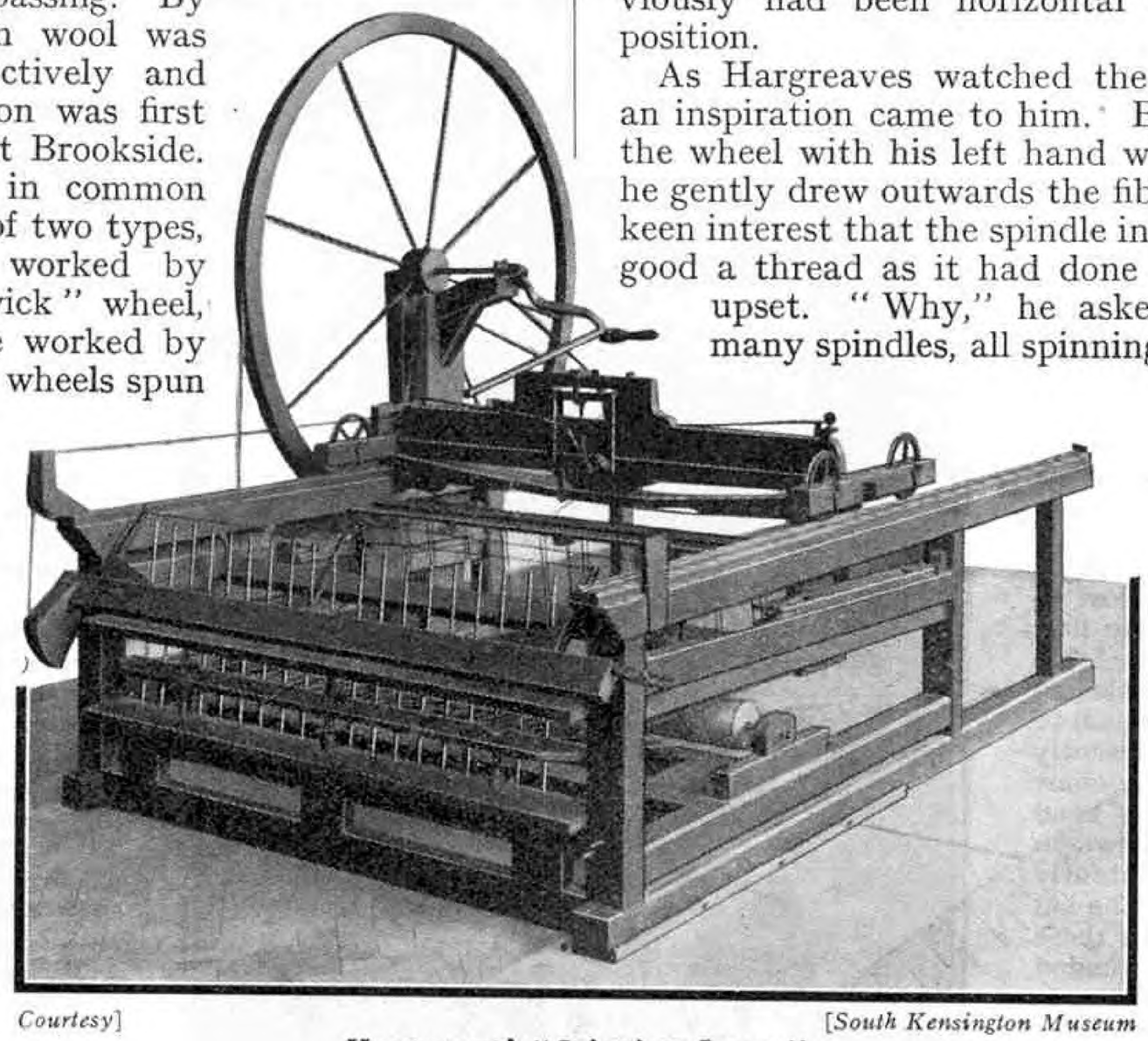
The spinning wheels in common use at that period were of two types, the "Jersey" wheel, worked by hand, and the "Brunswick" wheel, equipped with a treadle worked by the foot. Both types of wheels spun only one thread at a time, and spinning had to be periodically stopped while the spun thread was wound.

On the hand looms the family weaver worked the spun cotton thread and the linen yarn into finished cloth. The task was strenuous and slow, as the heavy shuttle bearing the weft thread had to be passed by hand through the "shed" or opening made when certain of the weft threads were raised. The "flying" shuttle invented by John Kay of Bolton about 1750, as described in the article on silk manufacture in the *"M.M."* of December last, more than doubled the productivity of the loom, and as a result of its adoption spinners were unable to provide weft fast enough to keep the weavers fully employed. It became a common occurrence for a weaver to have to leave home early in the morning in search of supplies of weft and tramp three or four miles, inquiring at the cottage of every spinner along the route, before he succeeded in collecting sufficient weft to serve him for the remainder of the day. It soon became apparent that an early improvement in spinning machinery was necessary in order to overcome this difficulty.

In 1761 the Society of Arts sought to encourage an early solution of the problem by offering a reward "for the best invention of a machine that will spin six threads of wool, flax, hemp, or cotton at one time, and that will require only one person to work and attend it." During the ensuing two years several aspirants for the prize submitted contrivances. Of these, one was selected in 1763 for detailed examination by a committee of manufacturers, upon whose subsequent recommendation a reward was granted to the individual who had put forward the device. The award would appear to have been in the nature of a compromise, however, as there is no evidence of the invention, whatever it was, having been put into practice. In the following year Hargreaves devised his famous "Spinning Jenny."

There are different versions of the circumstances which led Hargreaves to invent his spinning machine. According to one account he accompanied a friend one night to a local hostelry called the Pack Horse Inn, where they found a jolly company assembled in the kitchen, and the daughter of the house busy at her spinning wheel. While Hargreaves was in the room the girl in rising accidently overturned the spinning wheel. As it lay on the floor, the wheel that before had been upright was now horizontal and the spindle that previously had been horizontal was now in a vertical position.

As Hargreaves watched the wheel revolving slowly an inspiration came to him. Bending down, he turned the wheel with his left hand while with his other hand he gently drew outwards the fibre of cotton, noting with keen interest that the spindle in its new position made as good a thread as it had done before the machine was upset. "Why," he asked himself, "should not many spindles, all spinning upright, all moved by a band crossing them from the wheel, like this single spindle, each carrying a bobbin and having a roving of cotton attached, be made to work simultaneously?" He realised that with such a machine a much greater quantity of yarn could be spun, and the necessity of purchasing weft from other spinners would be obviated.



Courtesy] *[South Kensington Museum*

Hargreaves' "Spinning Jenny"

Hargreaves returned home with his mind full of this new idea, and when midnight came he was still pondering it deeply. At length the spinning jenny was planned, and during the ensuing months he devoted his leisure time to constructing an actual model. Numerous difficulties cropped up but all were overcome and eventually the machine was completed.

The invention consisted of a large oblong wooden frame at one end of which was a row of eight vertical spindles, while a second row of the same number was accommodated in an inclined rack fixed across the centre of the frame. The spindles of this rack carried the carded cotton, the fibres of which passed up to and around the short vertical pegs of a locking device. The latter consisted of two horizontal wooden bars, one above the other, extending the full width of the machine frame and mounted on wheels whereby the clamp could be moved along a grooved track on the top of the frame. From the clamp, the cotton fibres, or rovings as they are termed in respect to the spinning process, were led downward in a slanting direction to the end row of spindles.

In operating the machine the spinner, standing at the end of the frame opposite the vertical spindles, used his right hand to turn the large wheel fitted at one side of the frame and bearing an endless belt that rotated a roller situated between the two rows of spindles. This roller or shaft extended across the bottom of the frame and around it passed short endless belts which also passed around whorls on the spindles and thus rotated the latter. The clamp having been closed and

locked, the spinner drew it slowly towards him with his left hand, until the cotton fibres were attenuated to the required degree. The spindles revolved at a high speed and the cotton was raised up so that it slipped off the inclined spindles in the form of tiny loops. Thus twisting of the thread took place. As the clamp was returned to its normal position near the centre of the frame and the bars were eased up, the spun thread wound upon the vertical spindles and the cycle of operations was then repeated. It is said that Hargreaves' wife was such an excellent spinner that she was known locally as "Spinning Jenny" and that it was as a compliment to her that he bestowed that title upon his invention.

An interesting story is told in connection with this invention. It so happened that, on the night when Hargreaves received his great inspiration, one of Peel's sons was returning home over the moors late at night. As he approached Hargreaves' cottage he was surprised to see a light. Being curious as to what Hargreaves was doing out of bed at such an unusual hour, the boy peeped in at the window. He saw Hargreaves lying full length on the floor drawing mysterious-looking lines and circles with a stick charred at the end, while his wife with her baby in her arms sat watching intently. After a few moments Hargreaves rose and went across to the fire to burn his stick afresh and, apparently quite lost in thought, he grasped his bristly hair with his free hand and rubbed his forehead and nose with the blackened stick held in the other hand, much to young Peel's amusement. Presently Hargreaves sat down upon a chair and, leaning forward with his head between his hands and his elbows on his knees, he gazed long and intently at the diagrams on the floor. The lad was mystified beyond words by these strange goings on and as he wended his way home he came to the conclusion that Hargreaves was either thinking out some new invention or had gone completely out of his mind!

The first spinning jenny constructed by Hargreaves was used by his wife and children to spin thread for his loom, and as he had prophesied, the family output of weft was now so much increased that it was no longer necessary for him to tramp around in search of weft with which to complete his weaving. It was inevitable that sooner or later the local hand-loom weavers would begin to ask how it was that Hargreaves no longer needed additional weft and yet had more calico than ever to sell.

At last the secret leaked out, and when it became known also that one of his machines had been installed in the Brookside mill, anger and alarm were evidenced on every side. The fact that the invention effected a substantial saving in time and labour was nothing to the uneducated weavers, who saw in the machines merely an astute move to decrease employment. Hargreaves was denounced as a traitor to his fellow men and accused of deliberately "taking the bread out of the mouths" of the dependent weavers.

The tide of indignation at length rose beyond control and one night in 1767 a crowd of irate weavers from Darwen, Mellor, Tockholes and other places gathered in Blackburn and marched to Hargreaves' home. To their great regret the inventor was absent, but they gave vent to their feelings by forcing an entrance into the cottage, smashing up the spinning jenny they found there, and completely destroying his household furniture. On departing they left behind a written intimation that unless he ceased making and using his machines worse would befall him. The mob then tramped to the Brookside mill, where they carried out wholesale destruction.

Faced with bankruptcy, Hargreaves accepted the offers of certain manufacturers to secretly make them a few of his machines, and with the money derived from the sale of these he was able to remove with his family to Nottingham. There he made the acquaintance of a carpenter named Thomas James who, on learning of the invention, at once realised its great possibilities and offered to enter into partnership with Hargreaves. An agreement was drawn up, James courageously used his life savings to finance the undertaking, and the two men then commenced to build machines. The partnership proved a financial success and within two years they were able to patent the invention. The machine was patented on 12th July, 1770, as "a method of making a wheel or engine of an entirely new construction . . . in order for spinning, drawing, and twisting cotton, and to be managed by one person only, and that the wheel or engine will spin . . . sixteen or more threads at one time. . . ."



Young Peel, peeping through the window, sees Hargreaves working out the rough outline of his Spinning Jenny

In addition to the fierce opposition of the weavers to the spinning jenny, Hargreaves was faced with the proverbially difficult task of convincing the millowners that the machines that had served them well up to that time must be abandoned in favour of the new invention, which was infinitely more efficient in every respect. Gradually, however, the Lancashire manufacturers realised the position and began to instal spinning jennies in their factories, first experimentally and then in rapidly increasing numbers. If all had gone well Hargreaves and his partner would quickly have made a great fortune, but many of the millowners, ignoring the inventor's patent rights entirely, commenced building spinning jennies for themselves.

It was not long before Hargreaves found out what was going on and he immediately took steps to assert his rights. As soon as it became known that he was about to commence legal proceedings, the owners prepared for a strenuous battle. They realised that if Hargreaves won his case they would be faced with very heavy payments, and they immediately engaged a number of the cleverest and most experienced counsel in the country to defend them. The opposing sides never came to grips, however. Hargreaves' counsel apparently were not feeling too happy about the legal strength of the opposite side, and when in addition they found out that the inventor had sold certain machines while his invention had been unprotected by patent, they declined to proceed.

In consequence of Hargreaves' case collapsing in this manner, the millowners were able to ignore the patent rights and carry on with the building of their own machines. The inventor was thus, to a very large extent, deprived of the fruits of his invention.

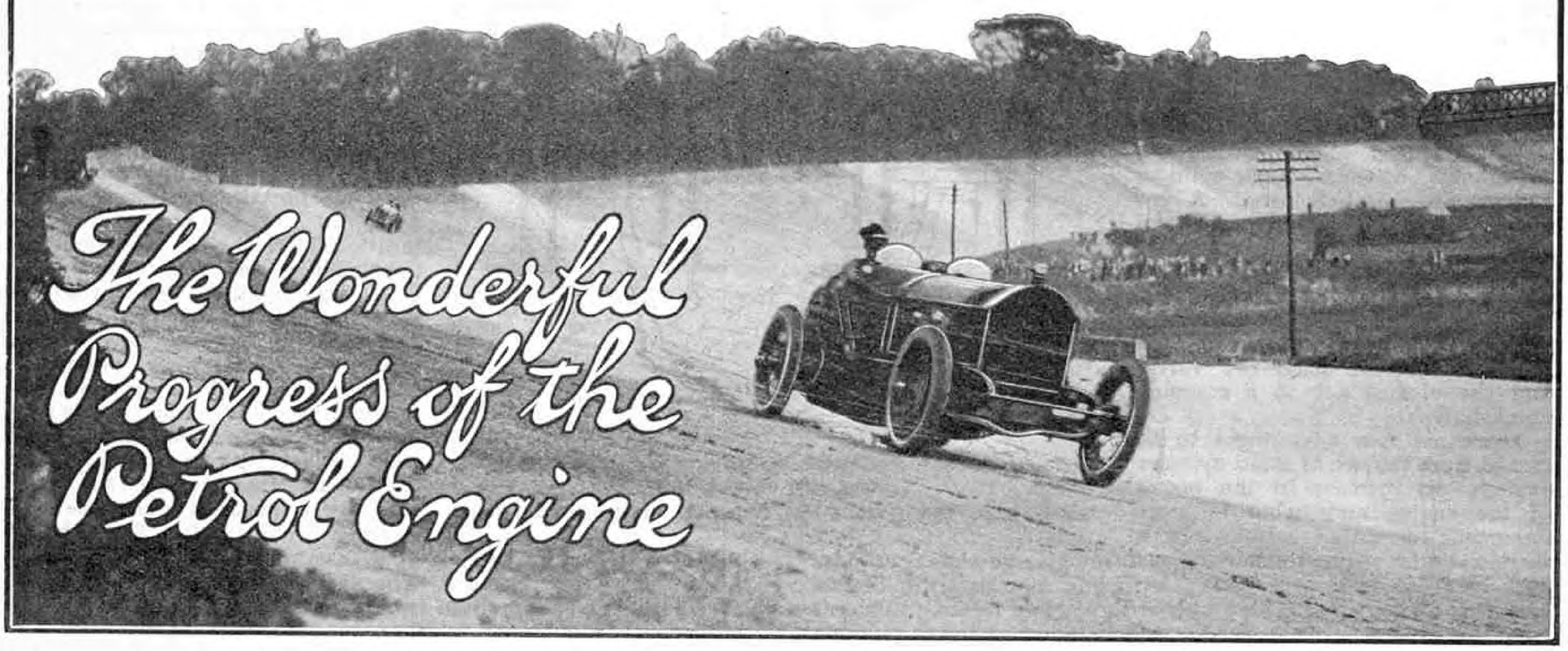
It is an interesting fact that all the great inventors of this period suffered in some degree from violence on the part of misguided mobs who believed that the introduction of machinery would deprive them of their living; and also from difficulties in enforcing their patent rights and deriving the benefit of their genius.

Arkwright, with whom we shall deal in a later article, was a notable exception, in that he succeeded in making his machines successful from a commercial point of view, in spite of the fact that he failed to uphold his patents.

It has frequently been stated, on the authority of Arkwright and others, that Hargreaves died in obscurity and great distress. This does not appear to have been the case, however, and it is fairly certain that at the time of his death Hargreaves had accumulated a modest fortune of some £5,000 or £6,000. Exactly what happened to this money does not seem to be known, but subsequently the inventor's children were found to be living in abject poverty, and a fund was organised for their relief.

The spinning jenny of Hargreaves was a thoroughly efficient machine so far as it went, but many improvements were necessary in order to make it capable of turning out work with sufficient rapidity. Ultimately, machines of this type were produced capable of operating simultaneously as many as 80 spindles. As time went on, even these machines became unequal to the production required of them, and to-day the spinning jenny is entirely superseded by great power-driven machines, the output of which would have filled Hargreaves with amazement.

The STORY OF THE MOTOR CAR



II.—HOW THE FOUR-STROKE ENGINE WORKS

In the first article of this series that appeared in last month's "M.M." we described the early efforts of inventors to produce an efficient steam-driven road vehicle, and how the development of the petrol engine ultimately solved the problem of road transport. This month we deal with the operation of the four-stroke engine, and show how the propelling power is derived from the burning of a mixture of petrol vapour and air, by means of a piston working in a cylinder.

LAST month's article in this series dealt with the motor-car in its early days, and it was remarked that the introduction of an internal combustion engine working on the four-cycle of Beau de Rochas made the modern car possible. The first practical engines working on this principle were the gas engines made by Otto of Germany, and hence the four-cycle is very often referred to as the Otto cycle. A thorough understanding of this in its application to petrol engines is a necessary preliminary to a knowledge of the mechanism of the motor-car.

The operations carried out during each of the four strokes of the piston were described briefly last month, and now must be dealt with more fully. The accompanying diagrams, Figs. 1—4, will make the details clear. They show the cylinder head and the piston, the valves and the connecting rod, in the positions taken up during each stroke. The valves shown in the diagrams are of the "poppet" variety. A valve of this type is mushroom-shaped with a long stem. Round the circumference under the head is a ring where the surface is ground to fit tightly on a corresponding surface at the ends of each of the two passages through which the gaseous mixture is introduced and the burnt gases are led away respectively. The valves are lifted from their seats by the action of cams on a shaft that is rotated by the engine at the requisite speed and are returned by powerful springs.

Two valves are necessary for each cylinder. One opens or closes the opening through which the explosive mixture reaches the cylinder, and is called the inlet valve. This is shown on the left in the diagrams. The second valve controls the entrance to the pipe communicating with the atmosphere, and is called the exhaust valve.

Starting with the piston at the top of the cylinder, the purpose of the first downward stroke (Fig. 1) is to fill the cylinder with the explosive mixture. At the beginning of the stroke the inlet valve opens, and as the piston descends the mixture is drawn into the increased space available until the limit of movement is reached. When the revolution of the crankshaft starts the piston on its return journey upward (Fig. 2), the inlet valve closes. The mixture already in the cylinder has no way of escape, and thus is compressed by the piston during the second stroke.

At the end of this second stroke the mixture is ready for firing. The petrol vapour and air of which it consists have been thoroughly mixed together and also slightly heated by compression. The most important effect of the compression, however, is to make the explosion that is now to be brought about much more effective than if the mixture were at ordinary atmospheric pressure. At this stage, therefore, an electric spark is passed across the points of a plug placed in a suitable position in the cylinder, and the mixture is fired.

The rapid burning of the petrol vapour immediately causes a great rise in temperature and an enormous increase in pressure. As both valves remain closed (Fig. 3), the power of the explosion drives the piston downward once more. This third stroke is the power stroke for which the two previous strokes of the cycle have made preparation.

The fourth or final stroke (Fig. 4), has for its object the removal of the products of combustion and the restoration of the conditions existing at the beginning of the cycle so that operations may commence anew. In order to bring this about, the exhaust valve now opens—the inlet valve still remaining closed—and the return of the piston after the explosion drives out the burnt gases by way of the exhaust pipe. When the piston reaches the top of the cylinder at the end of this stroke the exhaust valve closes and everything is ready for a repetition of the whole cycle.

The action of the four-stroke internal combustion engine consists of a succession of cycles of this character. It is important to note that a working stroke comes only once in each cycle. In order to assist in maintaining the speed of the engine during the three idle strokes of the piston a heavy flywheel is fitted to the crankshaft.

The method by which the lifting of the valves is accomplished is shown in the diagrams. Considering the inlet valve, it will be seen that the bulge of the cam must come under the stem of the valve once only during each cycle, and this is brought about by rotating the cam shaft once for every two revolutions of the crankshaft. Accordingly the gears taking the drive from the crankshaft to the cam shaft are arranged to effect this slowing down. The same applies to the exhaust valve. One cam shaft may be made to serve both valves, if these are conveniently

placed, by setting the points of the respective cams at right angles to each other as shown in the diagrams, in which the two valves are placed on opposite sides of the cylinders in order to make their action clear.

The spark that ignites the mixture in the cylinder also requires accurate timing. It must occur at the end of the second stroke, and this is accomplished by gearing a rotating distributor to the crankshaft of the engine. The distributor closes an electric circuit and sends a spark across the points of the plug at exactly the right time.

It is possible to make a successful engine with one cylinder, and engines of this type have been developed to a wonderful pitch of efficiency in the modern motor cycle. For motor cars, however, single-cylinder engines are unsatisfactory. A few small cars have engines with two cylinders, while eight or even twelve cylinders are used in the engines of some large and expensive cars, but the great majority have four or six cylinders. Each of the cylinders has the usual two valves and the pistons act on a common crankshaft.

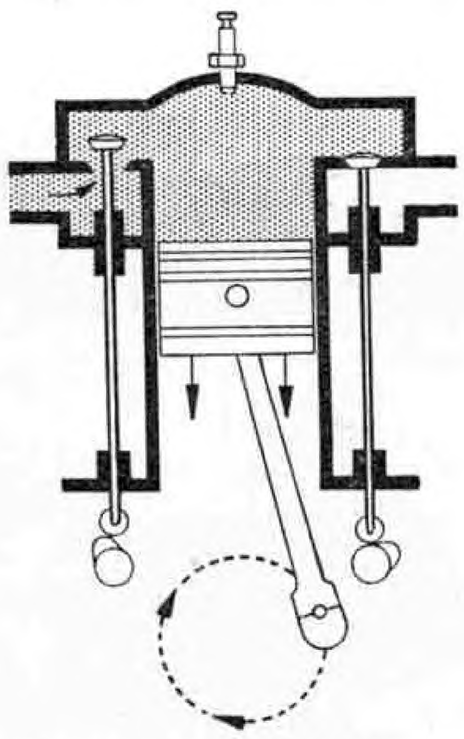
There are two advantages to be gained from the use of multi-cylinder engines—an increase in the power of the engine and, what is more important, smoother action. In a single-cylinder engine the moving parts are given a violent impulse once in every two revolutions. By using four or six cylinders and arranging the cranks suitably it is possible to have different operations taking place in the various cylinders at the same time, thus spreading four or six impulses evenly over the same number of revolutions of the engine. The result is that the pull is more even, and vibration is lessened.

The cylinders are usually numbered in order from one end. In the case of a four-cylinder engine the firing is usually arranged in the order 1, 3, 4, 2, while in six-cylinder engines the order may be 1, 4, 2, 6, 3, 5, or the reverse of this, 1, 5, 3, 6, 2, 4. The object is to spread out the impulses as widely as possible to assist in giving an even torque or turning power without undue vibration.

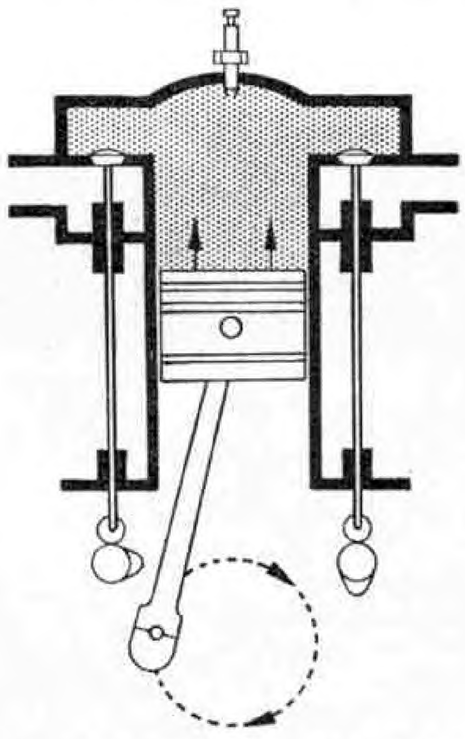
Another important point in this connection is the balancing of the moving parts of the engine. Some of the heavy metallic parts are rotating at a high speed while others are reciprocating, that is, moving backward and forward in a straight line. If due precautions are not taken, the effect of the movements may give the engine a tendency to rock. A perfectly balanced engine is practically an impossibility, but it is easier to balance the movements of the parts in a multi-cylinder engine than in one with a single cylinder, and a remarkable degree of success has been obtained in high-class engines. If, in a four-cylinder engine, the pistons all moved upward and downward at the same time, the tendency to rock would be considerable. With the order of firing given above the outer pair of pistons always move in the opposite direction to the inner pair, as will be easily realised when it is noted that the explosion strokes in the cylinders numbered 3 and 4 follow each other. Improved balance is thus attained.

Another requirement of a motor-car engine is that it must work at a suitable temperature. Heat is generated by the explosions taking place within the cylinders, and without special precautions the expansion of the metal due to heating would have the effect of distorting the cylinders and pistons, while the petrol vapour itself would be ignited immediately on entering the cylinder instead of at the proper time. Water is therefore circulated round the cylinders to keep the temperature down, and this water in its turn is cooled by passing through tubes or other narrow spaces in a radiator cooled by an air draught. In a few cases cooling is effected directly by air instead of through the medium of water. Finally, oil must be supplied to lubricate the moving parts and to assist in cooling by the prevention of friction.

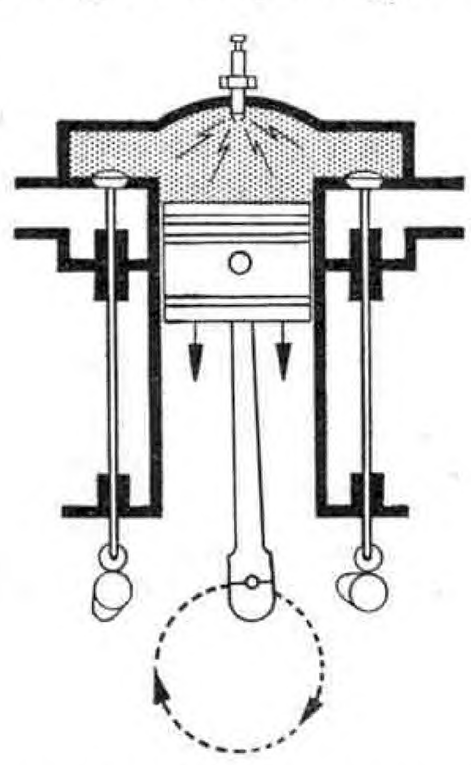
It will be seen that in practice the four-stroke motor becomes a somewhat complicated piece of machinery. In addition to the cylinders, pistons and valves, it is necessary to have a magneto or some equivalent instrument for igniting the explosive mixture, a carburetter to supply the latter, a water circulating system for cooling, and some means of lubrication.



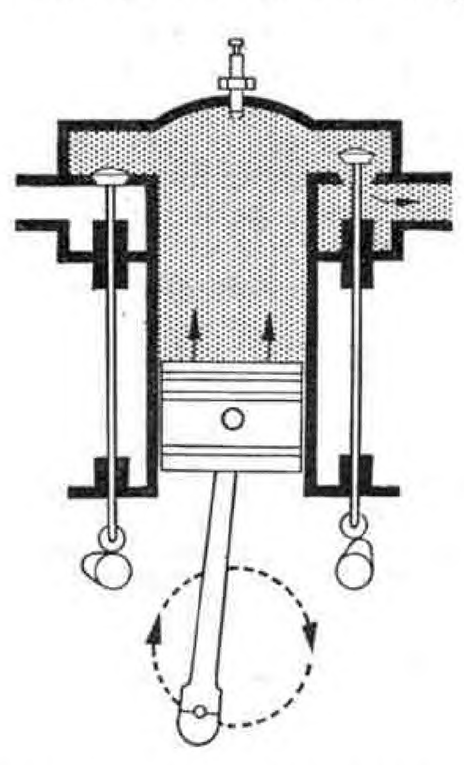
(Left) Fig. 1. Induction Stroke, the explosive mixture entering by the inlet valve on the left.



(Right) Fig. 2. Compression Stroke, during which both valves are closed



(Left) Fig. 3. Explosion Stroke, the piston being forced down by the explosion of the compressed mixture.



(Right) Fig. 4. Exhaust Stroke, during which the burnt gases are expelled through the exhaust valve on the right

Dealing first with the engine itself, we may take the four-cylinder engine as typical. The modern practice is to cast the cylinders in one block in order to obtain rigidity. Such a casting is by no means simple, as spaces for water circulation must be provided in addition to positions for valves, inlet and exhaust pipes, and the plugs.

A simplification was introduced in the Ford car in the shape of a detachable cylinder head. This made production work easier and cheaper, and all doubts of the possibilities of making a gas-tight joint where the head fitted were soon set at rest in practice, with the result that to-day the great majority of cars use a detachable head.

The cylinder block is firmly bolted down to the crank case, as it is essential to secure a rigid connection between the two. The crank case is usually made in two parts, and aluminium is now very largely used in its construction. The upper portion supports the crankshaft, and is suspended from the frame of the chassis or from a specially provided sub-frame, three-point suspension being used. The bearings carrying the crankshaft may be only two in number in a small engine, but in a four-cylinder engine there are usually three, while in some larger engines even more are provided to prevent bending of the shaft. The lower portion of the crank case contains the oil reservoir, or sump, and the pump used in distributing the oil to various parts of the engine.

Between the cylinder and the crankshaft come the pistons and connecting rods. These are very important parts of the engine. The explosion in the cylinder drives down the piston, which must slide easily along the walls of the cylinder and yet must adhere so closely that the gas in the space above the piston cannot escape, although under pressure, as much of the power derived from the explosion would thus be lost.

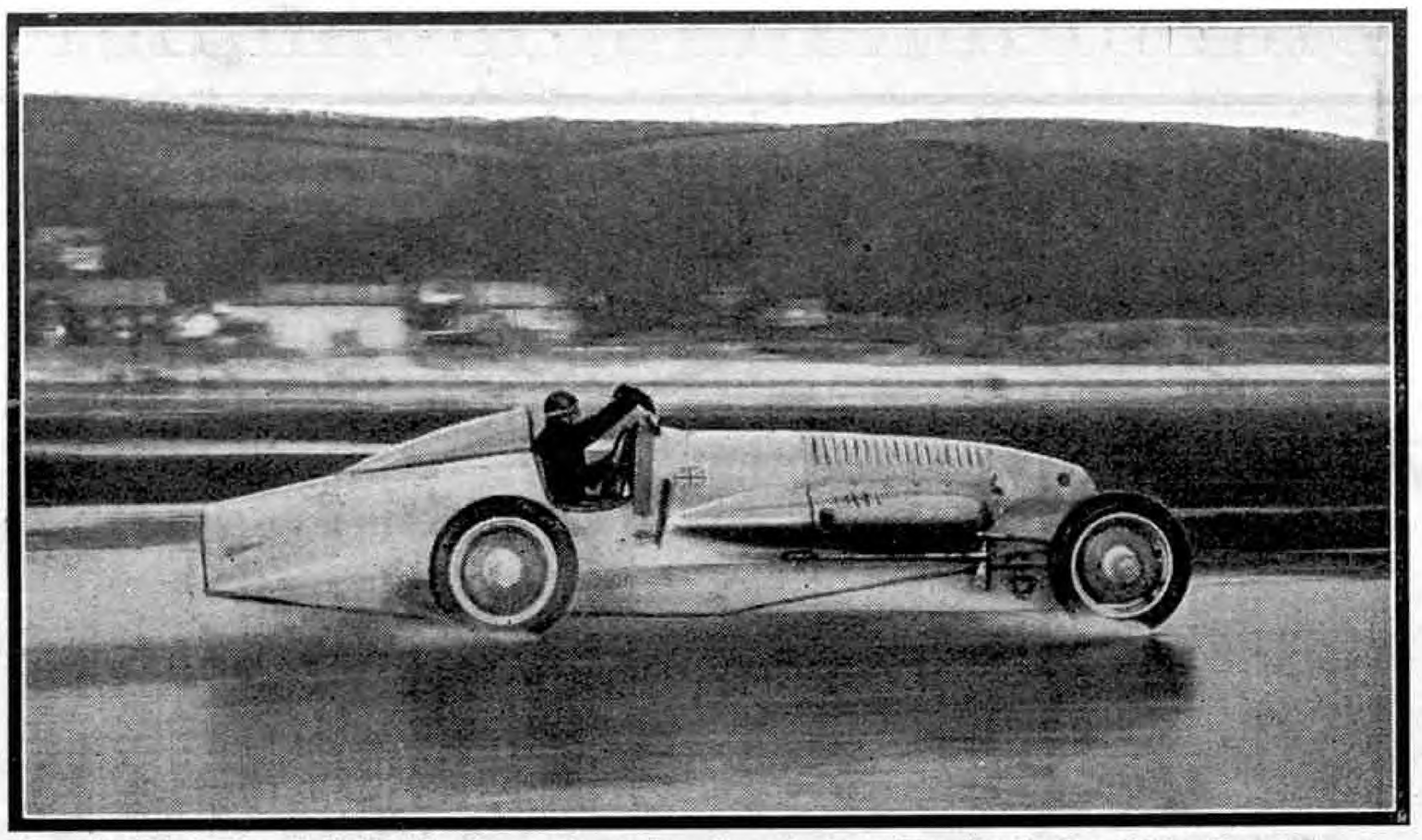
The two chief agents in satisfying these conditions are piston rings and lubricating oil. The skirt or side wall of the piston of an internal combustion engine extends considerably further than is the case with that of a steam engine, so that in effect the piston is a cylindrical box open at the lower end. Around the skirt are three grooves of rectangular cross-section to contain the piston rings. These are cast iron rings with internal diameter slightly less than that of the piston, and external diameter slightly greater than that of the cylinder. A narrow section is cut out from them so that they may be sprung open sufficiently to slip into the grooves provided for them. The cuts in the rings are made at an angle, and in assembling the engine care is taken not to have the cuts vertically above each other, in order to minimise leakage through the narrow gaps.

As a rule three rings are fitted on each piston. The spring of the rings keeps them pressed tightly against the sides of the cylinder, but in spite of all precautions a proportion of oil leaks past them and is burnt in the explosion chamber. This results in the deposit of a layer of carbon on the piston head, and this layer must be removed from time to time.

In the ordinary way the friction between the rings thus fitted

and the cylinder wall would result in the production of heat, in addition to absorbing much of the power derived from the explosion. The actual clearance between the two is so small that a slight expansion produced by overheating would cause the piston to "seize," that is to get stuck in the cylinder. This is avoided by the use of oil splashed on to the cylinder wall, a thin film being always present between the surface of the latter and that of the rings.

Most pistons to-day are made of aluminium alloy. Lightness is essential in these moving parts in order to make balancing easier. Although apparently simple, the design of a piston requires great care and thought. The temperature produced by the burning of the gaseous mixture is enormous, and the top or crown of the piston is specially liable to overheating on account of its position. Uneven heating would result in the distortion of the piston, with disastrous effect on the efficiency of the engine. To avoid this special attention is paid to internal cooling by oil, and internal webs are also provided to serve the double purpose of strengthening the piston and conducting the heat away quickly from its crown.



Captain Malcolm Campbell attacking the speed record on the water-logged Pendine Sands. Wiping the windscreen while travelling at top speed !

To translate the reciprocating motion of the piston into rotation at the crankshaft a connecting rod is used, which acts in exactly the same manner as the driving rod that connects the cross-head to one of the driving wheels in a locomotive. This rod is a short, stiff steel stamping, H-shaped in cross-section, that takes the whole of the thrust due to the power of the explosion, and must necessarily be strong. The end that is attached to the crankshaft is called the big end. It carries a split bearing, the two halves of which are bolted together round the crank pin.

The bearing surface takes various forms. Often it is a lining of white metal, a tin alloy containing small proportions of antimony and copper, carefully fitted to the crankshaft surface. The latter, of course, must be free to rotate within the bearing, and careful lubrication is necessary to prevent overheating with consequent melting of the lining. Recently, ball or roller bearings have been introduced. These are free from many of the defects of plain bearings and seem likely in future to be still more used than they are at present.

A similar bearing at the other end of the connecting rod is clamped on the gudgeon pin, a case-hardened rod or pin securely fixed across the interior of the piston.

As already noted, the crankshaft of the four-cylinder engine is so arranged that the inner pair of pistons move upward while the outward pair move downward, and *vice versa*. In addition the weights of the pistons and rods are carefully equalised. The purpose of this is to improve the balance of the engine. Another aid to better balance is the provision of rotating weights on the crankshaft to counterbalance the weights of the rotating big ends. They are usually attached to the webs, or parts of the crankshaft joining the crank pins, and in consequence these often take the form of circular discs. The cranks in such an engine are all in one plane, as they are at the extreme ends of their movements at exactly the same time. This is not the case when six cylinders are used, and it is then necessary to arrange the cranks in pairs in three planes with angles of 120° between them.

The important part played by lubricating oil will already have become clear. Efficient lubrication is indeed an absolute necessity in an internal combustion engine, and a shortage of oil in any one of several places may result in the complete failure of an engine. Two systems of lubrication are in use. The first and simpler one is the splash system. In this troughs of oil are so placed that scoops or dippers attached to the big ends splash oil inside the crank case so that it reaches the cylinder walls and the interior of the piston, in addition to running down to the big ends. The oil then drains away to a sump at the bottom of the crank case, whence the fly-wheel or a pump, usually the latter, delivers it through a filter into the troughs once more.

The splash method is quite efficient with ordinary engines, but it gives inadequate lubrication with high-speed or high-efficiency engines, for which pressure lubrication is adopted. In this method oil is forced through the pipes to any portion of the engine requiring it, so that lubrication is direct and positive. When the method is fully carried out a somewhat complicated system of tubing is necessary and, except on very special cars, splashing is relied upon for lubricating cylinder walls and gudgeon pin bearings, while the pressure feed is used for the important crankshaft bearings.

The prevention of overheating of the engine is important, if only because efficient lubrication is impossible when the oil becomes too hot. The dissipation of the heat produced in the engine is not a difficult matter, as it may be transferred through the cylinder walls to water circulating round them and cooled in a radiator. This water is circulated by means of a pump in most cases. The pump is placed at the lowest part of the cooling system and it delivers cooled water from the bottom of the radiator to the spaces surrounding the cylinders.

In a few small cars it is possible to dispense with a pump, as a natural circulation is set up quite easily. The water when heated becomes less dense and rises to the top of the radiator, where the highest point in the system is situated. Colder water from the bottom of the radiator naturally takes its place and in its turn rises further when heated. This method of circulating the cooler water is generally described as thermosyphonic. Whether a pump is used or not, the water descends through the narrow spaces in a radiator placed in front of the car, through which a powerful fan induces a cooling draught of air. Cooling by air alone has been tried and found successful for a few small cars, and particularly for motor cycles. When this method is adopted the cylinders have fins attached to them to assist in radiating the heat.

The water passages in the cylinder block and the pipes to and from the radiator must be arranged so that each cylinder receives its full share of the cooling water. Even cooling is just as necessary as even heating if distortion is to be prevented. Some means of controlling the temperature is provided on many modern cars to ensure that the engine works under the best temperature conditions. In cold weather over-cooling is prevented by the use of adjustable shutters on the radiator to reduce the draught, or by short-circuiting some of the water so that it does not pass through the radiator at all.

In the latter case the by-pass is opened automatically by a thermostat, a device for maintaining a constant temperature. The principle involved will be understood by considering its application to gas heating. Here the contraction or expansion of a quantity of liquid is made to open or close a by-pass tube that supplies extra gas to the flame when the temperature falls too low and is closed when the temperature returns to the desired level.

In the case of the cooling water of a motor car engine a liquid is used that boils at the maximum temperature desired at the top of the radiator. The by-pass for the water remains open until this temperature is reached, when the increase of pressure due to the vaporisation of the liquid in a corrugated container closes the valve, thus causing the whole of the cooling water to pass through the radiator.

In well-designed cars over-heating should not happen, except perhaps when long hills are climbed in hot weather with a following wind. When the cooling water boils in any other circumstances, it is an almost certain indication that something is wrong with the engine.

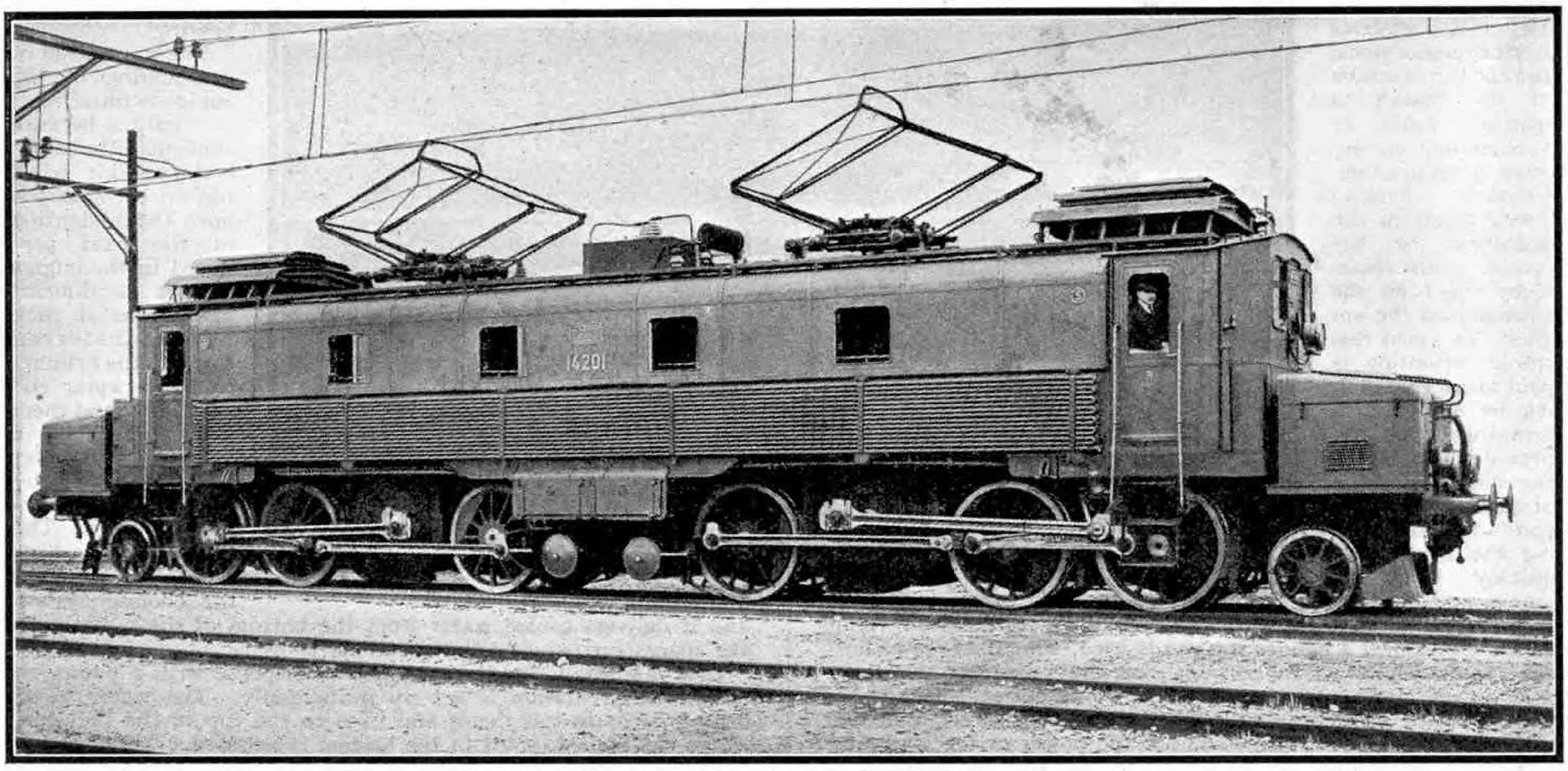
(To be continued)

FAMOUS TRAINS: XV.

The St. Gotthard Pullman Express

Swiss Federal Railways

By Cecil J. Allen, M.Inst.T., etc.



An Electric Locomotive of the Swiss Federal Railways

THERE is a special purpose in the transfer of our attention this month from the railways of Great Britain to those of Central Europe. It is that we may see at first-hand some of the most wonderful railway engineering in the world. The train itself will this month, indeed, be of but secondary importance, as our attention throughout will be concentrated on the unforgettable scenes to be witnessed from the carriage windows. We shall not, it is true, set eyes on any single engineering work of such stupendous size as the Forth Bridge, over which we rode last month; but from beginning to end of the journey we shall see the railway engineer at grips with Nature in her wildest mood, fighting his hardest to lay through the mountains a trail of steel which, when complete, is of such steepness as to oppose the greatest difficulties to operation by ordinary adhesion methods.

Switzerland is a central country in Europe, and through it have been laid some of the most important of the European trunk lines. But athwart the country, from north-east to south-west, lie two vast mountain barriers. The more northerly of the two is the narrow Jura range, and then, after we have crossed the valley of the Aare, we find the remainder of the country practically filled with the great chain of the Alps. It is the latter that constitutes the chief obstacle. The principal peaks soar upward to heights of 13,000, 14,000 and even 15,000 ft., and the passes that separate the mountain groups are often, at their lowest, more than 6,000 or 7,000 ft. above sea-level. To raise the main lines of railway up to any such altitudes would be impossible, and the only method of carrying the railways under the crests of the watersheds has been that of tunnelling. It is not surprising, therefore, that several of the world's longes tunnels pierce the Alpine chain. The Simplon, 12.3 miles; the St. Gotthard, 9.3 miles; the Lötschberg, 9.0 miles; and the Ricken, 5.3 miles, among the Alps proper, with the Grenchenberg, 5.3 miles, and the Hauenstein, 5.1 miles, through the Jura range, are remarkable examples in Swiss territory. The Franco-Italian Mont Cenis Tunnel, 8.0 miles, and the Austrian Arlberg, 6.4 miles, are other closely-adjacent Alpine tunnels.



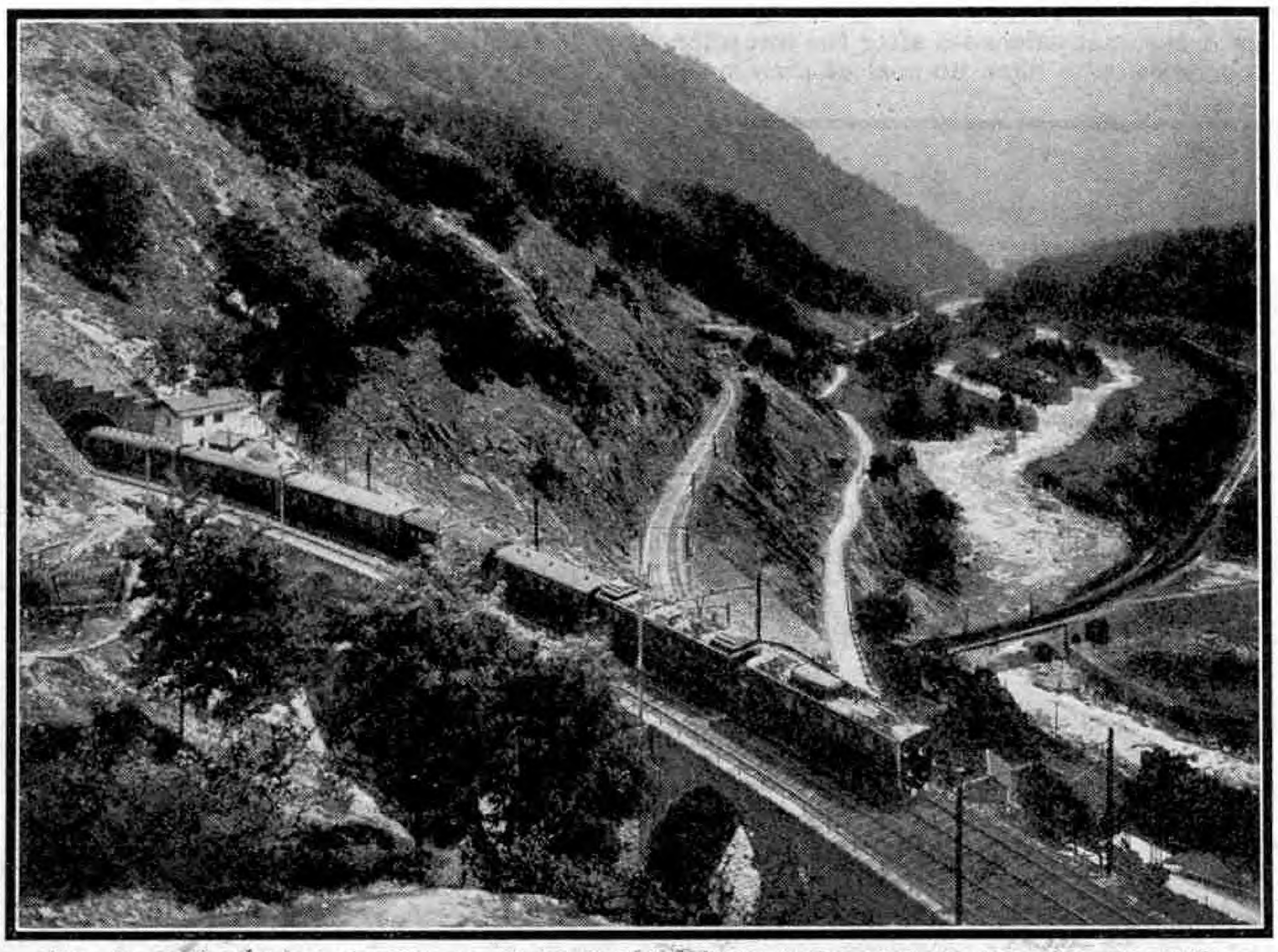
The Northern Portal of the St. Gotthard Tunnel

Even the approaches to these lengthy bores have proved in many cases a matter of great engineering difficulty. The floors of the mountain valleys up which the railways rise are irregular and uneven, and on the average they rise into the mountains at a steeper inclination than the steepest gradient up which any adhesion locomotive could pass. Very often, indeed, there are the most abrupt changes of level in the bottoms of the valleys, especially at points where the valley torrents rush through wild rapids and drop down by waterfalls.

The engineer, however, must make his line rise on an even grade, and though such inclinations as 1 in 40 are comparatively common on the main lines of Switzerland, it will be seen

that some of the routes that are the most notable for their engineering achievements only manage to preserve such a grade as this by means of the most desperate expedients. The lines may be made to double back on themselves in order to gain altitude, or even to turn into the mountain sides and, by completely spiral tunnels, raise themselves sufficiently to keep pace with some sudden change in the valley level.

It can be claimed, without fear of contradiction, that two of the Swiss main lines overshadow all the others in the boldness of their engineering. One of these is the Lötschberg line—opened in 1913 and most recent of all the Swiss main routes—threading its way from Spiez, on the Lake of Thun, southward through Kandersteg and the Lötschberg Tunnel out into the Rhone Valley, to join the Simplon route at Brigue, and so to give direct communication from Berne to Milan. The other is the St. Gotthard line, cutting straight down through the centre of Switzerland from Basel through Lucerne, Bellinzona and Lugano to Chiasso, where connection is made with the Italian State Railways, near Como. The St. Gotthard route forms the highway from Southern Germany to Milan and Northern Italy.



The St. Gotthard Line near Giornico (Swiss Federal Railways) as seen from above (see page 216). The middle loop line is shown in the centre of the photograph, running parallel with the road

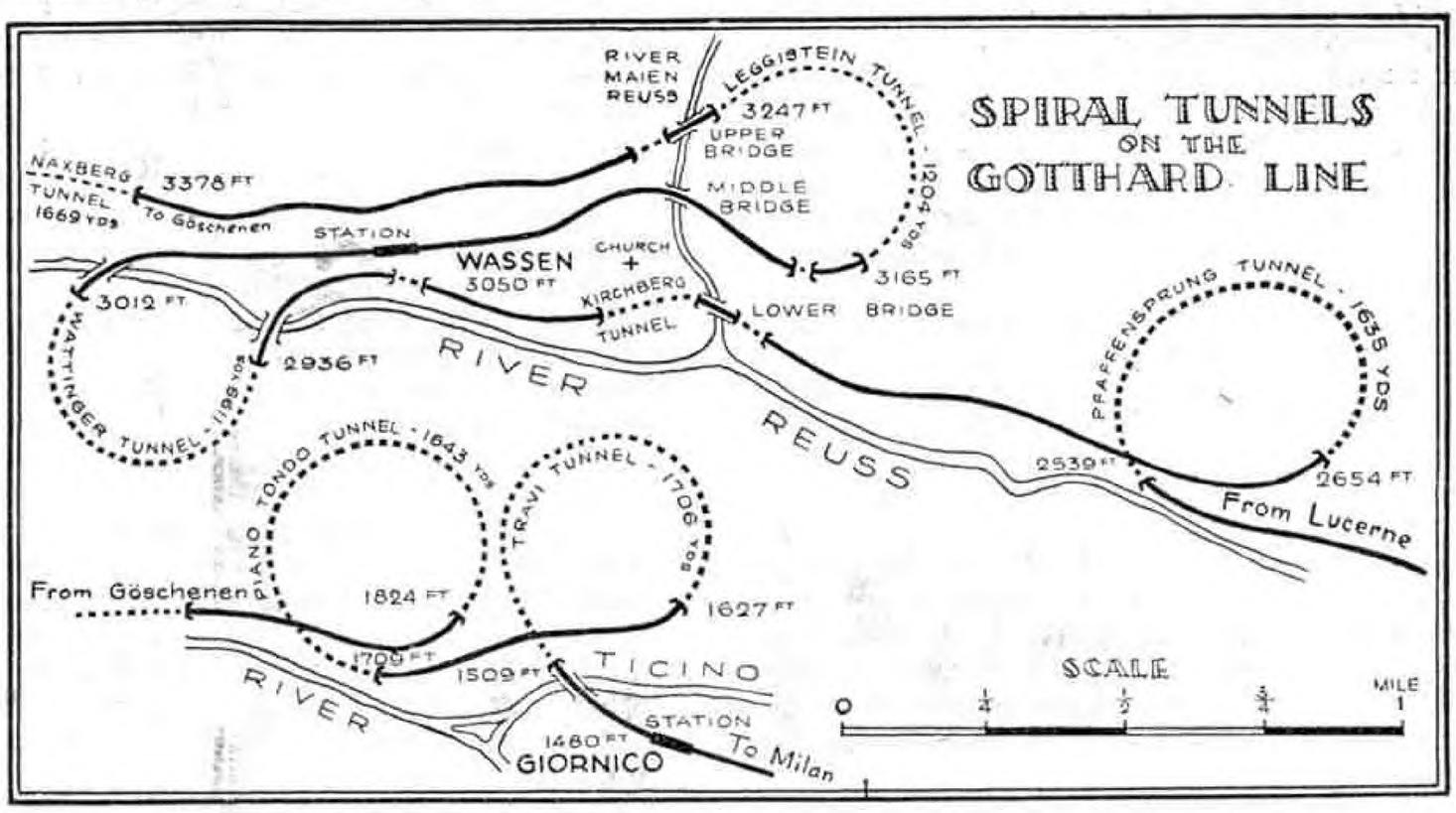
There are other wonder-railways in the east of Switzerland—the remarkable Rhaetian Railway system and the Bernina Railway, covering the great Canton of the Grisons—but these are single-track lines, the engineering of which was in some degree simplified by the use of the narrower metre gauge.

It is over the St. Gotthard main line that we are to travel this month, and as it is a happier experience to change from winter to spring than from spring to winter, we will make our journey in the southbound direction. First, then, we have to make our way to Basel, the northern gateway of Switzerland. We have plenty of ways of doing this, the best and quickest of which I sampled last summer—the special Swiss night express, connecting with the 4 p.m. service from Victoria Station in London.

Leaving Calais at 7.50 in the evening, this "flyer" makes its way right across France, through Amiens, Laon (well to the north of Paris, where we pass from the care of the Nord to that of the Est Company), Châlons, Belfort and Mulhouse into Basel, at an average speed but a shade under 50 m.p.h. The 432½ miles from Calais to Belfort, indeed, are covered in 8 hrs. 38 min., at an average rate of 50.1 m.p.h. This is an object-lesson to our "*Aberdonian*" of last month, with its average rate of only 47.2 m.p.h. over the 393 miles between London and Edinburgh in both directions, and with fewer stops.

Punctual to time at 6.20 in the morning we draw into the most cosmopolitan station in Europe—the great "Bundesbahnhof" or Central station at Basel. We have nearly an hour to spare here before the departure of our train for the south, which is as well, for the railway-lover could spend days of absorbing interest in and about this wonderful railway centre. Trains are constantly arriving with coaches from every part of Eastern and Central Europe—French coaches of the Nord and Est Railways from Calais and Paris; Belgian coaches from Brussels; Dutch coaches from Amsterdam and the Hague, coaches from all the States and the principal cities in Germany; not to mention the coaches of the Swiss and Italian State Railways, returning homeward. The Swiss coaches all carry the neat legend "SBB-CFF" which indicates "Schweizerische Bundesbahnen—Chemins de Fer Fédéraux," or, being interpreted, "Swiss Federal Railways," in both German and French, which are the two languages chiefly spoken in this little country.

Sleeping cars are rolling in—the "Mitropa" sleepers of the purely German "Mittel Europische" organisation, which do not proceed beyond the frontier station of Basel, and the more familiar cars of the International Sleeping Car Company, going through to Swiss and Italian destinations. The coaches bear destination boards of all descriptions—eastward to Zurich, Chur in the Grisons, Innsbruck and Vienna; southward to Milan, Genoa and Rome; and south-westward to Berne and Geneva, to name but a few.



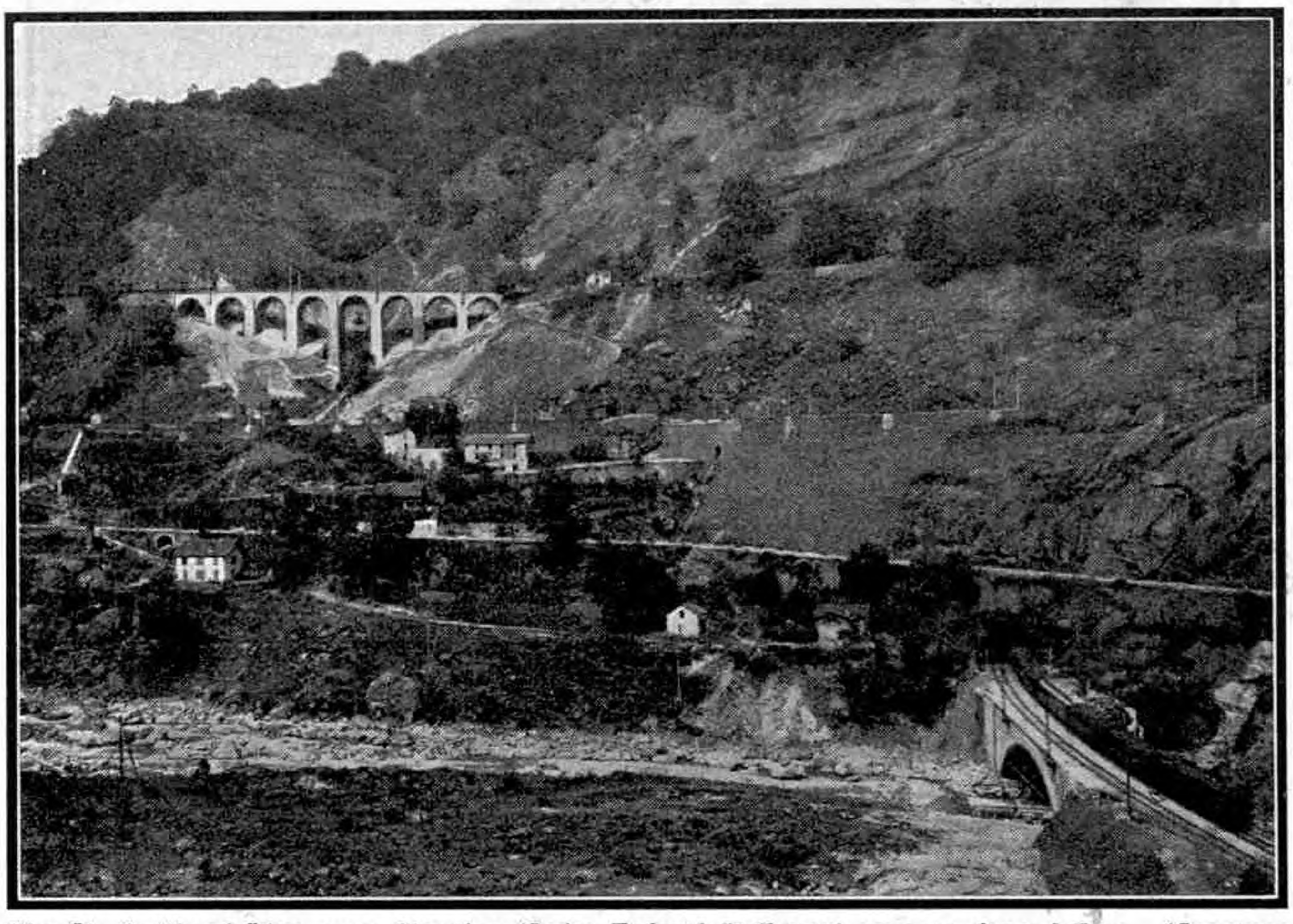
Map showing Tunnels on the St. Gotthard Line

And then we rub our eyes to see, drawn up in one of the platforms, a beautifully-appointed train in the familiar amber-and-cream livery of our own British Pullman cars. It is a Pullman train, right enough, and closer scrutiny of the cars reveals the satisfying fact that their source of origin is our own country. This is the St. Gotthard Pullman express, on which we are to travel. It is a special train, run daily in the spring and autumn seasons, while at other times in the year it is making journeys in other parts of Europe. The cars are of the 8-wheeled type whose acquaintance we have already made on the "*Golden Arrow*"—77 ft. in length, and for the most part weighing about 48 tons apiece. Second-class as well as first-class passengers are carried, on payment of the usual Pullman supplementary charge. As in the case of all the other Pullman Limited express trains of Europe, the passenger enjoys, in addition to the luxury of the travel, the advantage of faster journey times than those of

any other train service during the day, as a return for the extra fare. The "*St. Gotthard Pullman*," in fact, is ¾-hour quicker than the best ordinary express between Basel and Milan.

The Pullman services in Europe, which are constantly on the increase to-day, are all controlled by the International Sleeping Car Company.

Before taking our places in our luxurious car, we do not fail to notice that the haulage of our train is to be carried out by electricity, and not by steam. For many decades after the inception of their first railways the Swiss, who have no coal of their own, imported large quantities from neighbouring countries, and especially from Germany, for the working of their railways. To-day they realise that Nature, whom their engineers fought so desperately in the laying of their railways, has all the time been offering them, by way of compensation, a means of working the lines that in time will render Switzerland independent of all coal supplies. This compensation is the vast store of "white coal," or water power, perpetually available in any country which, like Switzerland, is filled with mountains whose mantles of snow and ice are always melting, under the influence of the sun, and rushing downward to the valleys.



The St. Gotthard Line near Giornico (Swiss Federal Railways) as seen from below. (Compare with view from above on page 215)

In every direction to-day these Swiss torrents are being harnessed and made to drive water-turbines; these in their turn drive dynamos and the dynamos produce electricity. For the purpose of working the railways large power-stations have been established, the biggest of which is the Barberine station in the Rhone Valley, which generates current at no less than 132,000 volts, and distributes it, by overhead transmission lines, to sub-stations all over the country. The St. Gotthard line has its own two power-stations, at Amsteg and Piotta, where current is generated at 66,000 volts. In every case there is a transformation down to 15,000 volts, which is the actual voltage of the alternating current in the overhead wires of the railway.

Some two-thirds of the railway mileage of Switzerland, including nearly all the main lines, have now been electrified, for the most part since the war; and we are to travel right across the country in the unbroken care of electric locomotives—the first such trip since these articles began.

The replacement of steam by electricity has made all the difference to the comfort of a traveller over a line like the St. Gotthard. Before the electrification the slow uphill passage of the steam locomotives, two or three of which were often needed to a train, filled the many tunnels with steam and sulphur, making the journeys dirty and tedious. To-day we shall forge steadily upward, maintaining an even speed of but little under 40 miles an hour up continuous grades of 1 in 38½ to 1 in 40 without the slightest apparent effort.

Punctual to time at 7.12 a.m. we are away. Drawing quickly out of Basel, over a maze of tracks, we notice on the left the enormous concentration sidings that are now in course of being laid out to deal with the exchange freight traffic between Switzerland and the neighbouring countries. Very soon we turn southward, out of the Rhine valley, and begin to ascend into the heart of the Jura mountains. These are for the most part between 3,000 and 4,000 ft. in height in this part of the country, but we have to rise some 520 ft. up the fertile Ergolz valley, in the first 17 miles to Tecknau, before we can get through. The original main line between Basel and Olten rose considerably higher, to a total of 920 ft. above Basel at the Upper Hauenstein Tunnel (1¾ miles in length), but the altitude has now been reduced by 400 ft. and the gradient greatly smoothed by the boring of the Lower Hauenstein Tunnel, 5⅛ miles in length, through which we pass in about eight minutes.

A brief downhill run and, crossing the swiftly-running River Aare, we roll into Olten at 7.48 a.m. This is the important junction between the main line from Geneva and Berne to Zurich and further east, and our main line from Basel to Lucerne, Lugano and Italy. It is of railway importance, too, as here are located the chief locomotive shops of the Swiss Federal Railways.

The first 24½ miles of our journey are now past, and have occupied 36 min.; our level above the sea is 1,310 ft., as compared with the 925 ft. of Basel. Least interesting of all the route, from the engineering point of view, is the next stretch, from Olten to Lucerne, which for the most part traverses a flat plain, covered at an average rate, apart from slowings, of about 50 miles an hour. But as we approach Lucerne, given clear weather, the snowy crests of the Alpine chain begin to bear into view ahead of us, brought up on the right by the rugged mass of the mountain called Pilatus. The rushing River Reuss, of which we are to see a great deal later on, joins us on the right, and a couple of short tunnels through mountain spurs usher us into the fine lakeside station at Lucerne, 58 miles from Basel. The 33½ miles from Olten have taken us 48 minutes, and it is now 8.37 a.m.

The Lake of Lucerne—or, as the Swiss call it, "Vierwaldstattersee," the "Lake of the Four Cantons"—is of a singular shape. It is like a cross of which the top is at Lucerne, and the two arms stretch out respectively to Kussnacht on the north-east and Alpnachstad on the south-west; while the long downward shaft proceeds eastward to Brunnen, and then takes a sudden right-angled bend to the southward, to Flüelen. At Lucerne we are in the foothills of the Alps; when we reach Flüelen we have penetrated to their heart.

To get away from Lucerne we have to retrace our tracks through the Gütsch Tunnel, to the point of divergence of the real St. Gotthard Railway, which curves right under the town in a tunnel 1¼ miles in length, and emerges on the lakeside. Owing to the peculiar configuration of the lake, the line does not follow its banks throughout, but curves round to the end of its eastern arm at Kussnacht, and from there passes round the back of the Rigi mountain, to rejoin the Lake of Lucerne at Brunnen. For sheer, breathless beauty, the view from the railway over the main "cross" of the lake, from between Lucerne and Kussnacht, in my judgment has no rival, with the fertile green pastures and the blue lake as a foreground, backed up by the dark green of the precipitous forest-clad slopes on the far side of the lake, and crowned by the eternal snows beyond.

From an altitude of 1,435 ft. at Lucerne, which we leave at 8.43 a.m., we rise gradually for 17 miles to Arth-Goldau. After leaving the Lake of Lucerne at Kussnacht, we hug the northern side of the Rigi, with the Lake of Zug far below us on the left. Arth-Goldau is an important junction, where a through set of Pullman cars from Zurich—the biggest city in Switzerland—is waiting attachment to our train. After this we have no publicly booked stop for 2¼ hours, during which we are to cover a distance of 88¾ miles through to Bellinzona. The stop at Arth-Goldau lasts from 9.11 to 9.18 a.m. Here we are 1,725 ft. above the sea, but the line now falls until we emerge on to the lakeside again at Brunnen,

to run down its southernmost stretch, through many tunnels (for the two sides of the lake are here mainly precipitous) to Flüelen.

We are about to enter the valley of the Reuss, but the first stage of the up-valley journey presents no great difficulties. It is not until we reach Erstfeld, 5½ miles from Flüelen and 37½ miles from Lucerne, that the climbing really begins. Here the single track expands to double, and so continues for the whole of the mountain section of the line.

Erstfeld was at one time a locomotive depot of importance, as it was here that the assistant locomotives were provided for the toilsome climb to the mouth of the St. Gotthard Tunnel at Göschenen. Every gradient that has been mentioned in these articles until now pales before the ruling gradient of the St. Gotthard line. From Erstfeld to Göschenen we are to rise unbrokenly at between 1 in 38½ and 1 in 40 for 18 miles, during the course of which we shall be lifted 2,080 ft. Directly we leave Erstfeld we begin to rise high up the east side of the Reuss Valley; so high, indeed, that just after passing Amsteg, three miles later, we have to fly over the Karstelenbach, rushing down the branch Maderanertal Valley to join the Reuss, by the immense two-span Karstelenbach Bridge, 178 ft. above the bed of the torrent. Prominent on the east side of the valley here is the vast pipe-line, bringing the water down to the Amsteg electric power-station which supplies this portion of the railway with current. A little later on we cross to the opposite bank of the Reuss by a bridge 256 ft. above the water.

Now follows one of those abrupt changes in the floor level of the Reuss Valley, to which reference has already been made. Just beyond Gurtnellen, 8½ miles from Erstfeld, the river-bed "catches up" the railway, despite the ceaseless ascent of the latter. The railway thereupon turns to the right, passes into the mountain side, and winds round in a tunnel which is a complete corkscrew in shape. In the course of its length of 1,635 yards the Pfaffensprung Tunnel raises the line 115 ft., and we emerge to look right down on the line over which we were running but a few minutes before. Once again, as we are approaching the village of Wassen, the line bids fair to drop below the river level, in spite of our continued climbing. This time we turn leftward and enter the mountain side. Curving round in a half-spiral we come out again to daylight, re-cross the Reuss, and double backward past the village—returning, that is to say, in the direction from which we have come, though still steadily rising.

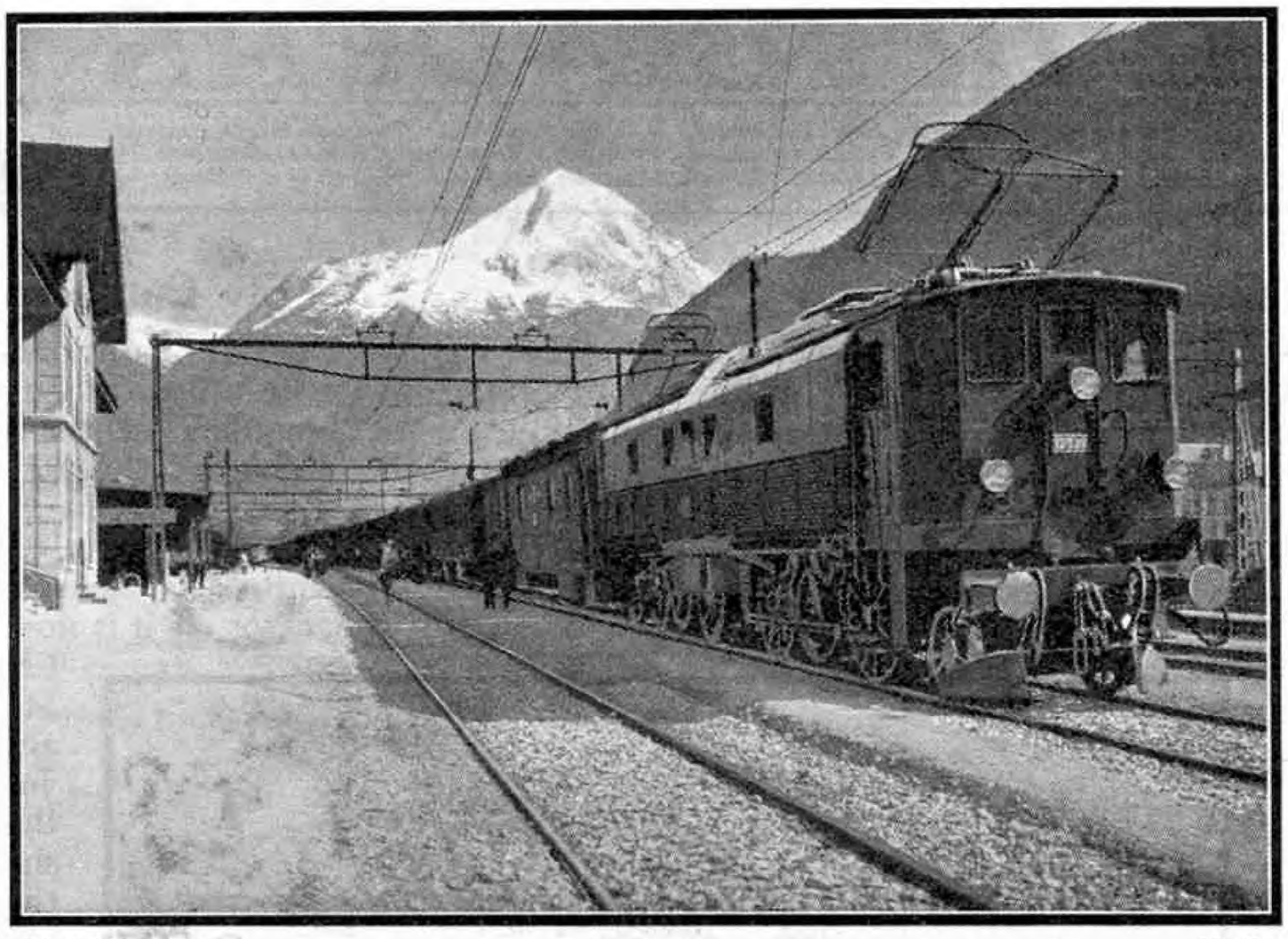


Photo by [*Ryffel*

Electric Train on the St. Gotthard Line at Erstfeld

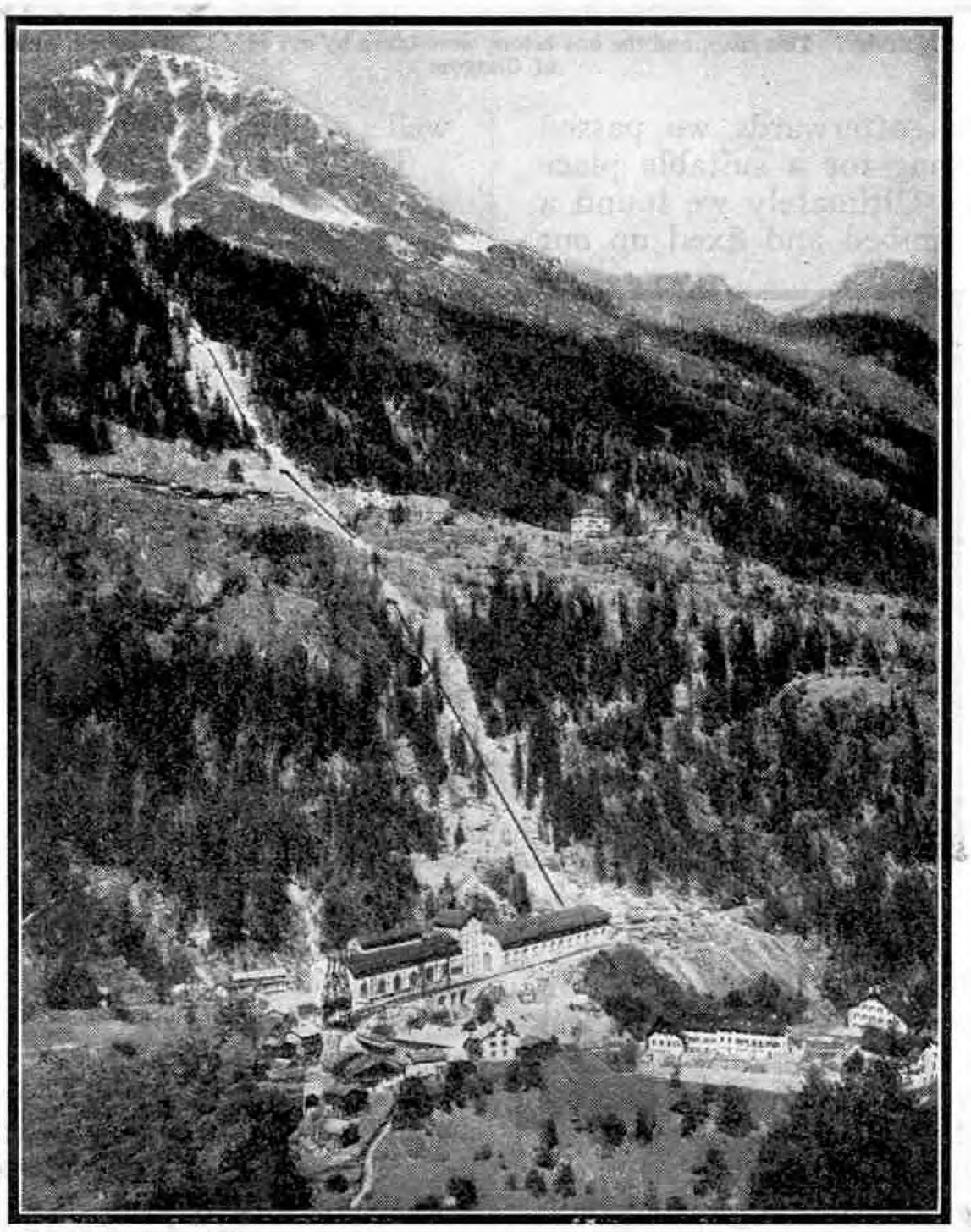
As we cross the Maienreuss—a branch stream—by an imposing girder bridge, we notice a railway bridge below us and another above us, crossing the same stream. Over the former we have already passed; the latter we shall cross in a few minutes. Turning again to the left into the hillside, the railway negotiates yet another spiral tunnel, and now emerges on its uppermost level, in its original up-valley direction, the engineers having lifted it no less than 400 ft. opposite the village of Wassen, by this extraordinary planning. Three miles more and we are at Göschenen, 3,640 ft. above the sea, and 55½ miles from Lucerne, where we shall probably make a momentary halt.

The Reuss Valley now contracts to a narrow defile, known as the Schöllenen Gorge, up which it was impossible to carry the railway further. The decision was therefore reached to bore under the watershed in a straight line for 9¼ miles, in order to cut through to the Ticino Valley, on the south side. It took the ten years from 1872 to 1882 in which to complete the St. Gotthard Tunnel, which was the first of the great Swiss Tunnels to be bored; it is 28 ft. in breadth, by 21 ft. in height, and cost in all some 57 millions of francs, or about £2,280,000. To-day, as a result of the electrification, we run through smoothly and easily in 13 or 14 minutes, and emerge at Airolo in what often seems another world. Last time I was over the St. Gotthard it was raining at Lucerne, snowing at Flüelen; there was a blizzard with snow lying deeply on the ground—like midwinter—at Göschenen, bright sun with snow higher up the mountains at Airolo, warmth and fertility at Bellinzona, and the temperature of an English early summer at Lugano—all within three hours.

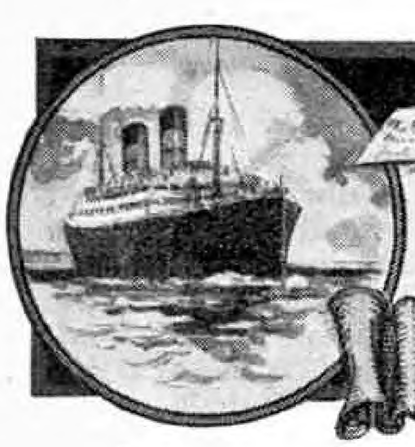
The highest point of the railway is actually in the centre of the tunnel, and is 3,786 ft. above the sea. From there we steadily fall, and after Airolo there comes a resumption of the 1 in 38½-40 ruling grade, but now, of course, in our favour. Nothing much of note occurs in the first five miles of the journey, until we reach Piotta, where on the left we see another immense pipe-line coming down the mountain side straight into the Piotta power-house, which also supplies current to the railway.

At the side of the pipe-line is one of the famous Swiss funicular railways which, in the course of ¾-mile ascending to Ambri,

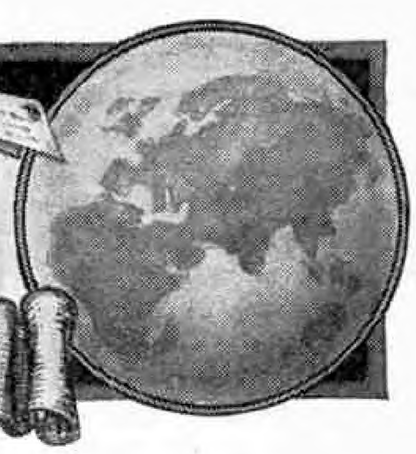
(*Continued on page* 238)



The Power-plant of the Swiss Federal Railways at Barberine



FROM OUR READERS

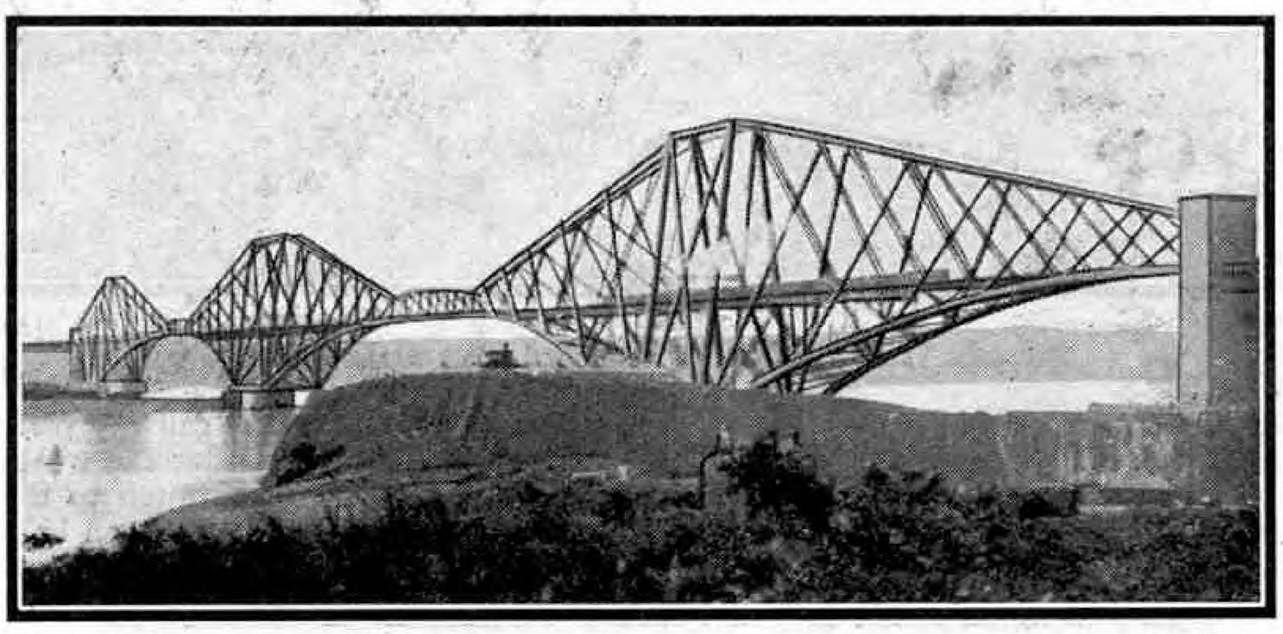


Contributions not exceeding 500 words are invited, with or without photographs or sketches for use as illustrations, and payment will be made for all articles published. The Editor takes no responsibility for the accuracy of statements contained in such articles, nor for the opinions of contributors.

Visit to the Forth Bridge

Ever since I read the article on the Forth Bridge in the "*M.M.*" for October, 1925, my great desire has been to see this wonderful structure for myself and to cross it. Last year my desire was gratified, and very early on a certain July day my father and I left Queen Street Station, Glasgow, our train being drawn by "Director" No. 6391, "*Wizard of the Moor.*" At Dalmeny the bridge came into view and at 9.14 our train steamed on to the first cantilever. A warship was riding at anchor below the bridge and in spite of its huge size it looked no bigger than a Meccano model! Our train drew off the bridge at 9.18 and three minutes later pulled up at Inverkeithing Station, where we alighted.

Leaving the station we turned in the direction of the bridge, and after we had walked for about 20 minutes it came into view. Ten minutes afterwards we passed beneath it and set about looking for a suitable place from which to photograph it. Ultimately we found a high mound upon which we climbed and fixed up our apparatus, just as "Atlantic" No. 9871, "*Thane of Fife,*" came into sight and entered the most northerly cantilever. We snapped her just as she was leaving the first cantilever.

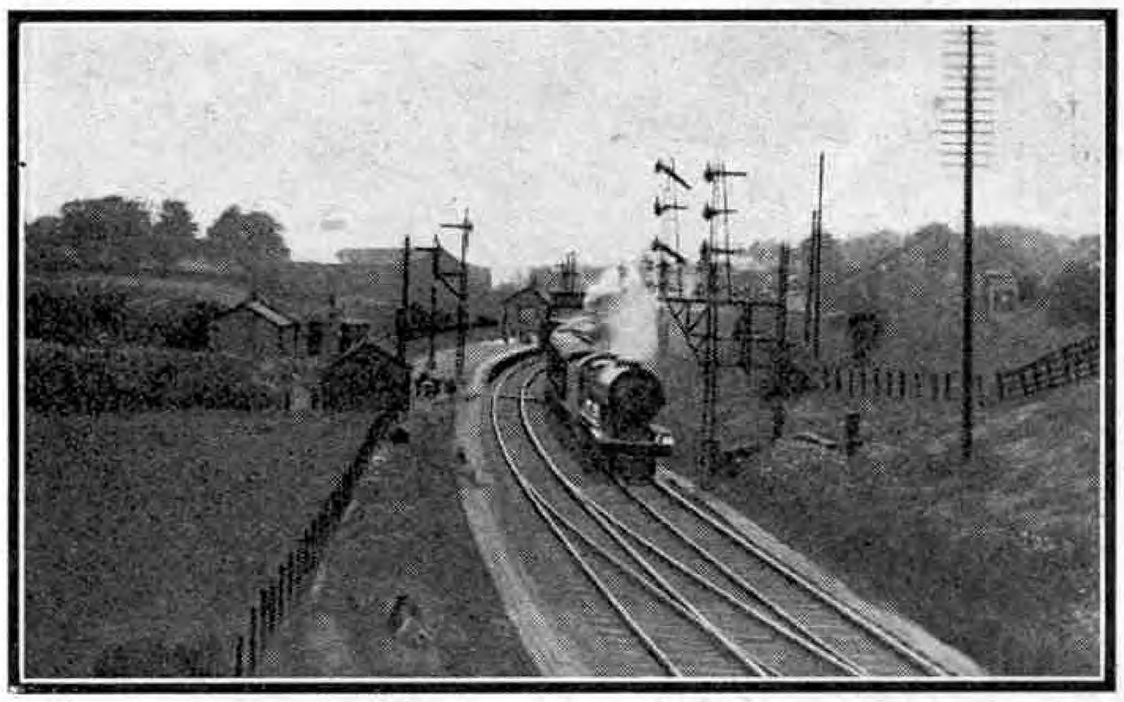


The Forth Bridge. This snap, and the one below, were taken by our reader, Donald W. Chisholm of Glasgow

After dinner we went for a walk up the town in the opposite direction from the bridge. At the junction of the Dunfermline line with the main north line we had an excellent view of the station, with the Forth Bridge in the distance and a number of signals in the foreground, so we rigged up the camera and waited for a train. Soon there came in sight the "*Thane of Fife*" on her return journey. She did not stop, and so it was a test for our skill in snapping her at the right moment.

Subsequently we hunted out various places of interest around the district until it was time for us to go home, and when our train finally drew up at Queen Street Station my father and I agreed that we had had a glorious day.

D. W. CHISHOLM (Springburn, Glasgow).



"Thane of Fife" pulling out of Inverkeithing Station. This station is at the junction of the lines to the south from Aberdeen and Inverness

Ely Cathedral

The city of Ely in Cambridgeshire owes its chief importance to its beautiful cathedral, which is of great antiquity. The building of the transept, the oldest portion of the present Cathedral, was commenced in 1081 by one Simeon, a Norman, and was completed in 1106, with the aid of certain bishops and others. It was converted into a Cathedral in 1109.

The Lady Chapel, or, as it is now called, Holy Trinity Chapel, was erected to St. Mary between 1321 and 1349 by a monk, John de Wisbech. In the Chapel is also the shrine of St. Etheldreda, the Queen of Northumbria, who founded the first Ely minster in 673. Round the wall are several stone figures whose heads have been knocked off, all except that of St. Etheldreda. This work of destruction is believed to have been carried out by Cromwell's soldiers during the Great Civil War.

The choir is very beautiful; at the western end is a screen, wonderfully carved. On the north side of the choir, above each stall, are twenty-five panels of wood, representing the New Testament, and on the south side, twenty-five other panels depicting the Old Testament. This beautiful work was done by Abeloos of Louvain. In the choir, as throughout the Cathedral, are magnificent stained-glass windows.

Behind the high altar is the Retro-choir, in which is an early muniment chest. To the north of the Retro-choir is Bishop Alcock's Chapel; here are fine sculpturing and wood carving. On the south side of the Retro-choir is the Chapel of Bishop West.

At the western end of the Choir is the Octagon, a mosaic-paved space enclosed in eight pillars, and above the Octagon is the Lantern Tower. The ceiling of the Nave was painted by Lestrange of Hunstanton; when he died, his friend completed the work in 1861. It represents some of the chief events in Bible history from the Creation to Christ's Resurrection and Ascension. On

the south wall of the Nave are some flags and colours which are relics of the Battle of Waterloo in 1815.

St. Catherine's Chapel is in the south-west Transept, and in the north Transept are the Chapel of St. Edmund and the War Memorial Chapel. The latter is perhaps one of the most beautiful parts of the Cathedral. The chief colours in it are green, scarlet and gold. A gilt-lettered inscription round the wall runs: "To the men of Cambridgeshire and Ely who gave their lives for their country in the Great War, 1914–1918." Below this, opening out of the wall, are panels on which are the names of the glorious dead.

The Cathedral is 537 ft. in length, and the height from the floor to the Lantern that crowns the Octagon is 142 ft. This occupies the place of the old Norman tower, which fell in 1321, and was constructed by Bishop Hotham. The western tower is 220 ft. in height. In front of it is the Galilee or western porch, which is Early English and was built in the early years of the 13th Century.

Although the Cathedral is built in a mixture of several styles of architecture and has an unfinished appearance it is nevertheless a noble structure, and will no doubt continue to be a centre of religious life for many years in addition to the 850 that have elapsed since its foundation. PEGGY HAWKS (Shortlands, Kent).

Ascending the Inside of a Factory Chimney

Some time ago I had the luck to be allowed to ascend a new works chimney. My guide took me to the base of the chimney in which a large hole had been left. Inside there was a small skip supported by a wire rope passing over a pulley at the top of the chimney and raised or lowered by an engine at the bottom. I went through the opening into what resembled a large circular room lit by electric light and with walls about a yard in thickness.

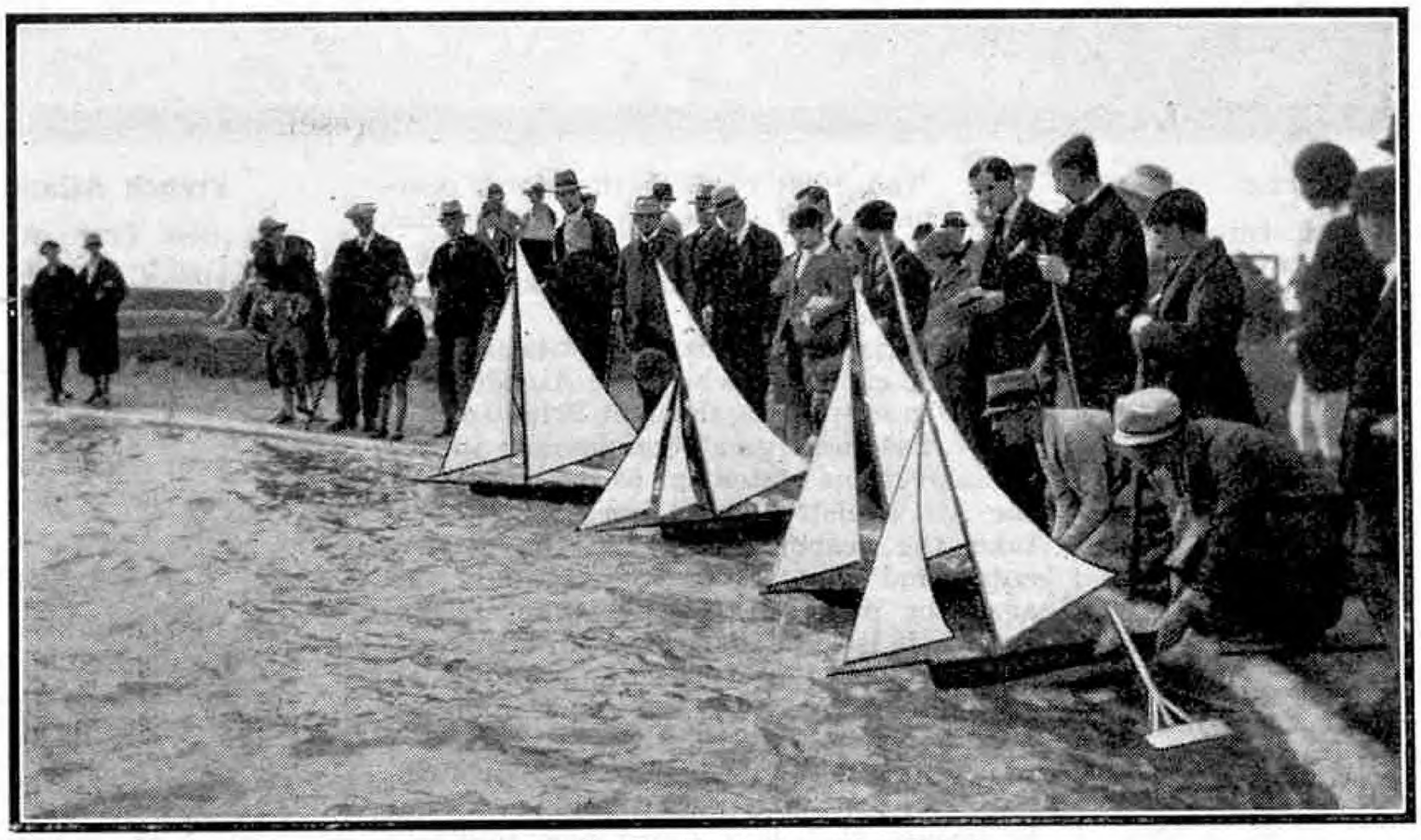
Shortly afterwards the skip descended, and my guide stood on one side of it and I on the other, each of us holding to the wire rope. A signal was then given and we were gently hauled up, the skip at first revolving slowly. Half way up the chimney it was nearly dark and we might almost have been ascending a mine shaft. Presently it grew lighter and in a moment we stepped off the skip on to a platform running around inside the chimney—180 ft. above ground. When I looked over the side I was amazed at the view and I gazed eagerly round for some minutes. Then it was time to descend, and taking our places once more on the skip we were slowly lowered down. So concluded one of my most interesting experiences.

L. H. TURNER (Manchester).

Model Yacht Racing

Model yacht sailing is one of the most interesting of outdoor hobbies and this is particularly the case when one is able to take part in races on a suitable lake.

During my holidays this year I spent a most enjoyable afternoon watching a number of heats contested. The yachts were divided into various classes according to length ranging perhaps from 15 in. to 36 in. They were then handicapped by one second to every inch of boat length; that is a yacht 26 in. in length was given four seconds start over a yacht that measured 30 in. The competitors were formed up in line for the start at one end of the lake, as shown in the accompanying photograph, and at the word "go" from the starter they placed their craft in the water. No pushing forward of the boats was allowed, the penalty being disqualification. Sometimes the boats turned from their course towards the sides of the lake and their owners were then allowed to turn them by means of a stick fitted with a rubber ferrule to prevent the boats being damaged. At the finishing point the competitors had to guide their boats between two flags attached to floats at the opposite end of the lake, and this required great skill as competitors were not allowed to drive their craft forward by hand.



Model Yacht Racing: The Start

The most popular class was that for small yachts, during which some 40 or 50 boys watched with eager eyes the progress of their boats. In addition, a large number of fine yachts were entered in the classes for larger boats. In the photograph the yacht third from the camera won the race, which was re-started three times owing to the boats becoming entangled. This meant that all the yachts had to be taken out of the water and the heat begun all over again. Sometimes on a rough day as many as seven or eight re-starts may have to be made before a race can be properly contested. The reason for this is, of course, that some boats do not steer themselves easily.

The construction of model yachts suitable for races of this kind is a science in itself. A model on a reduced scale of a successful full-sized yacht is not necessarily a fast boat, and may even be distinctly cranky in behaviour in the absence of a steersman. It is possible, however, by careful design of the bow to build models that hold their course with remarkable tenacity, while another important point in securing speed is that the bow and particularly the stern should be streamlined to reduce the retarding effect both when the water is divided and when it closes once more. T. O. DAWSON (Tyldesley).



Imperial Airways Progress

Some interesting facts concerning the operations of Imperial Airways in the year 1926—7 were given by Sir Eric Geddes in his speech at the recent annual meeting of the company.

During the year the increase in traffic amounted to 5,000 passengers, 75 tons of freight, and 10 tons of mail matter. A refutation of the statement that the majority of the company's passengers were American tourists was given in the analysis of the nationality of passengers; 45 per cent. were British and the remaining 55 per cent. was spread over several different nations. Throughout the 11 months' operations on the Cairo-Basra route, every flight was completed to schedule, while on the European services only 8 per cent. of the total journeys were irregular. On the Cairo-Basra line, the quantity of mail carried is increasing steadily. Approximately one-third of the total mail between England and Iraq, and over half the total incoming mail from Iraq, was conveyed by this line.

The difficulties over the Persian section of the projected Basra-Karachi route still exist and the through Egypt-India service is in abeyance in consequence. All arrangements are in hand to bring this complete service into operation immediately the Persian Government gives way. In the meantime an alternative route along the Arabian side of the Gulf is being arranged.

A specially interesting feature of the company's operations was the private hire service. On this over 60,000 miles were flown during the year, on newspaper distribution work, special charters for business houses, and short notice trips.

* * * *

D.H. Moth Experiments

Improvements are continually being made with the new D.H. Tiger-Moth and it is anticipated that before long it will be possible to secure a maximum speed performance of 200 m.p.h. Experiments are being carried out with a standard Moth fitted with the new D.H. engine. Some remarkable results have been obtained, and the publication of the performance figures is awaited with keen interest.

* * * *

The Next Schneider Trophy Race

The Federation Aeronautique Internationale, the controlling authority for the Schneider Trophy race, has agreed to the British and Italian Governments' suggested variation of the conditions laid down by M. Jacques Schneider, and in future the event will be held every second year. The 1928 race, is therefore, postponed until 1929. There is no doubt that 12 months is all too short a period in which to digest and apply the lessons of the previous race.

No official statement has yet been made as to the extent to which the Air Ministry will go in supporting the next British entry. There has been great controversy in the Press over one statement to the effect that the Air Ministry would not again undertake the responsibility for the British entry and that service pilots would not again be provided. Against that allegation there is to be placed the Air Minister's statement in the House of Commons on 19th December last, when speaking on the postponement of the 1928 race:—"Whether the contest is in fact held in 1928 or 1929, it is my intention to take all action necessary to ensure that this country is worthily represented and no effort spared to secure another victory." Pressed to state whether Air Force pilots would be provided, the Minister would not commit himself, but promised that the question would receive consideration.

* * * *

Colonel Lindbergh's Tour

In the course of a recent three months' tour carried out by arrangement with the trustees of the Daniel Guggenheim Fund for the Promotion of Aeronautics, Colonel Lindbergh covered a distance of 22,350 miles. He visited 82 cities and towns spread over the whole of the United States, and addressed over 30,000,000 people.

* * * *

Proposed Trans-Atlantic Flights

Mr. Clarence Chamberlin, who piloted Mr. Charles Levine across the Atlantic last summer, is to attempt to repeat the feat in the early part of this year. A machine has been specially designed for the attempt by Mr. Bellanca, the designer of "*Miss Columbia*," and this has a wing span of 100 ft. and will be propelled by four engines.

Other flights, from east to west, are being prepared for by Captains Hinchcliffe and Mackintosh, who are both pilots in the service of Imperial Airways Limited. Neither pilot will disclose details of the machine he is to fly, but both intend to get off as soon as weather conditions are favourable.

* * * *

It is rumoured in Paris that provision is to be made in the next French Budget for an expenditure of ten million francs on the development of seaplanes capable of beating all existing speed records and to win the Schneider Trophy.

French Atlantic Air Mail Service

A new Trans-Atlantic air mail service, operated by the French Latecoere Company, was opened on 22nd November last with a flight from Buenos Aires to Natal with 11 mail bags from Brazil, Europe, and the United States. The company will receive a Government subsidy of £1,000,000 for the year 1928 for the establishment of this service.

* * * *

R.100 Nearing Completion

R.100, the first of the new 5,000,000 cu. ft. commercial airships, is now rapidly approaching completion. This airship is being built at Howden by the Airship Guarantee Company to the order of the Air Ministry. The other ship, R.101, is being built by the Royal Airship Works at Cardington.

R.100 contains many novel features in its design. The framework is entirely of duralumin and the general arrangement follows closely the style of the Zeppelin. The accommodation for crew and passengers, including the control houses, is inside the main hull framing. The engine nacelles are of necessity placed outside the framing, but other than these there will be no projections to interfere with the general streamline design of the ship.

The power units will be six Rolls-Royce "Condor" engines, each developing 700 h.p., but details as to their exact arrangement are not yet available.

The general details of the ship are as follows:—Length 709 ft.; maximum diameter 130 ft.; displacement 5,000,000 cu. ft.; total lift 156 tons; fuel capacity 30 tons (this is included in the total lift); cruising speed 75 m.p.h.; cruising range 3,750 miles; estimated maximum speed 82 m.p.h.; paying load (estimated 100 passengers and 10 tons of freight) 24.5 tons; total power plant 4,200 h.p.

It is anticipated that the ship will be completed in April and will be immediately handed over to the Air Ministry for trials. The Aircraft Guarantee Company have an option to repurchase the airship from the Ministry subsequently, provided that the company are willing to undertake to run the vessel on an approved commercial service.

* * * *

Captain Malcolm Campbell, the racing motorist, has received the Air Ministry's sanction to use a Napier engine of the type built into the 1927 Schneider Cup winner, in a car with which he proposes to make an attempt on the world's record motor speed at Daytona Beach, Florida.

Aircraft-Carrying Submarines

A recent Admiralty announcement that aeronautical officers appointed to aircraft-carrying submarines were to be paid an extra allowance of 2/– per day is of particular interest as being the first public intimation that there are British submarines capable of carrying aircraft.

It may reasonably be assumed that this development of the Navy air-arm has passed beyond the experimental stage. Details as to the nature of the machines employed are still a closely guarded secret, but most probably they are seaplanes of a small type. An aeroplane could only be employed if a catapult launching apparatus and an aerial landing runway were available, and in spite of the great size of our latest submarines, one doubts the practicability of installing such apparatus. On the other hand, a seaplane could be stowed quite conveniently in a hatchway opening direct on to the ship's deck, from which it could easily be slipped overboard and just as easily picked up again from the water.

The development of aircraft-carrying submarines has already received considerable attention in France and the United States, and some very successful results have been obtained.

* * * *

The Vickers-Valiant

Vickers Ltd. have recently produced a new two-seater machine suitable for general fighting service. It is known as the "Valiant" and is an all-metal machine fitted with a Bristol-Jupiter 450/525 h.p. engine. It is suitable for reconnaissance, photographic and day bombing purposes, in addition to fighting.

Allowing for the crew, 130 gallons of petrol and the necessary oil, the machine can carry 1,115 lb. for seven hours with a cruising speed of 95 m.p.h. at a height of 15,000 ft. Its ultimate ceiling with this load is 19,000 ft., but with a lighter load it can climb to a point slightly more than 24,000 ft. Storage for petrol is provided in gravity-feed tanks carried in the inner bay of the outer top planes. No petrol at all is carried in the fuselage.

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Rhodesian Aviation Development

A company is now in process of formation in Buluwayo to take over the existing Rhodesian Aviation Syndicate with a view to extending its operations to cover every side of aviation. The new company is to be known as the Rhodesian Aviation Company Limited, and in addition to its commercial activities it proposes to open up a light aeroplane club and to form a flying school. The present company has been operating in Rhodesia for several months and possesses one D.H. 6 machine and a D.H. Moth 10.

The World's Speed Record

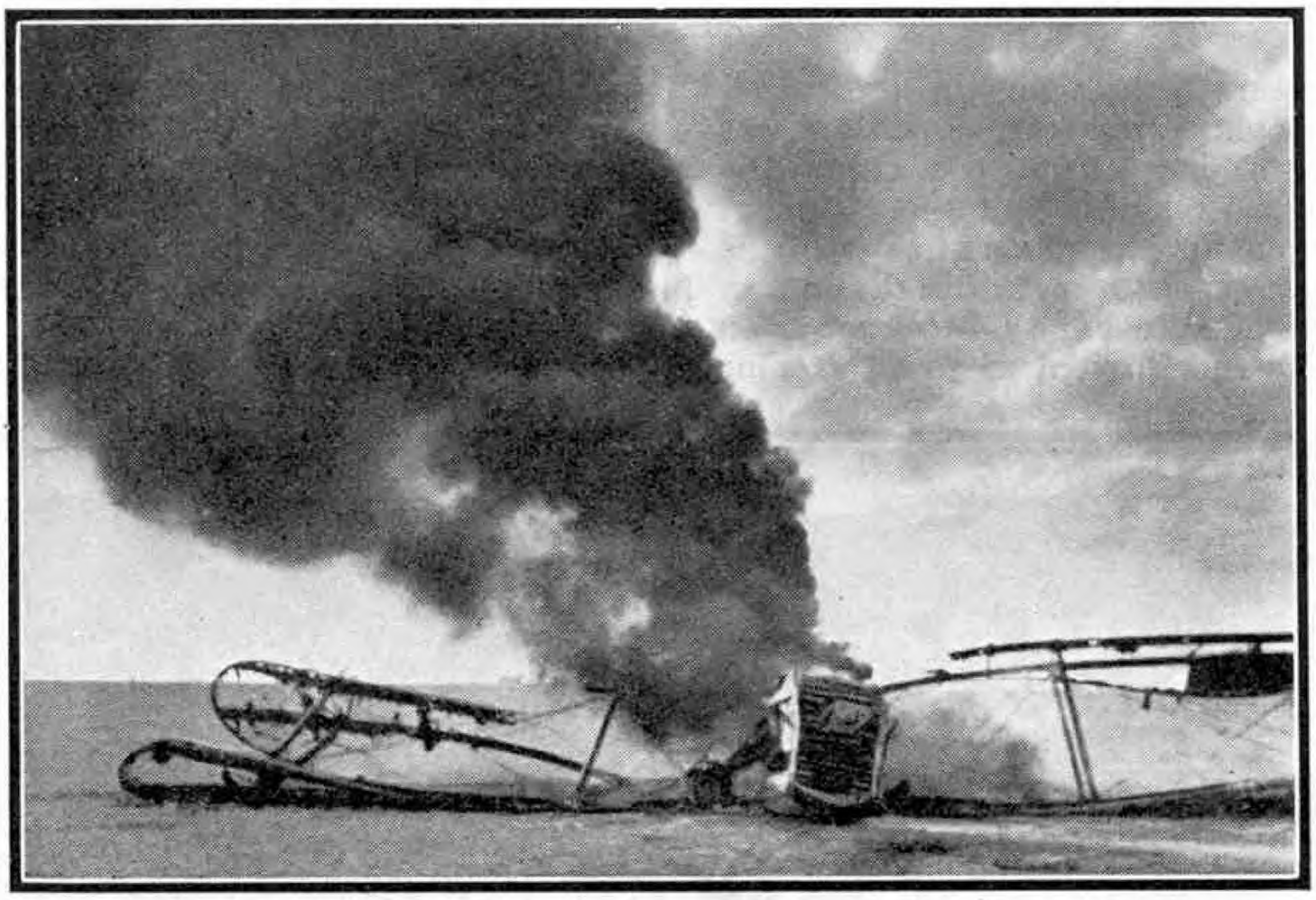
Colonel de Bernardi, the famous Italian pilot who was so unfortunate in the last Schneider Trophy contest, has not allowed Flight Lieut. Webster's speed record to stand for long. Flying one of the Macchi machines built for the Schneider race, Bernardi raised the speed record for the straight 6 km. course to 477.87 km. per hour (296.82 m.p.h.). This shows a speed slightly over 15 m.p.h. faster than that attained by Webster in the race (281.54 m.p.h.).

This official attempt on the speed record was carried out over the Lido course on 22nd October, and the figure given is the average of four flights, two in each direction. Flying downwind Bernardi actually touched 313.46 m.p.h., and thus secured for himself the honour of being the first man to travel at a speed exceeding 300 m.p.h.!

This feat is notable and deserves every credit. It should be remembered, however, that Webster's record was an average over a considerably longer distance, flown on a triangular course. It may be assumed also that Bernardi carried only sufficient petrol to cover the distance required in the tests, whereas Webster carried sufficient to see him through a complete race. This load question must, of course, have played a big part in increasing the Macchi's speed, and when the Supermarine S5 sets out to tackle Bernardi's record it is highly probable that it will be successful. The S5 machine that won the Schneider Trophy is being prepared for the attempt, which is to be made in the very near future.

* * * *

It is announced that the proposed airship service from Seville (Spain) across the South Atlantic to the Argentine is to be inaugurated by 12th October, the anniversary of the discovery of America by Columbus. The airship to be employed on the service is a Zeppelin No. L 127 which is expected to be ready for preliminary tests during the present month.



A striking photograph of a D.H. 9 machine bursting into flames, five seconds after crashing. The photograph was secured by a R.A.F. photographer in Egypt in 1925.

The machine made a bad landing in the first place and rebounded 70 ft. into the air. The engine "stalled" and the machine went into a spin and crashed. The pilot (Lt. D. H. Lawson) and observer got clear unharmed though badly shaken.

Inter-Empire Air Routes

An official announcement was made recently in South Africa that preliminary flights of airships between Great Britain and South Africa would be held in 1929, with a view to testing the possibilities of establishing a regular service. The mooring mast intended for the use of the big commercial ships now approaching completion at Howden and Cardington in England, is being assembled ready for erection as soon as the site for it is selected.

* *

Fire-Proof Petrol

The machines of the French Air Union are now employing an entirely new type of petrol that has been invented by a French Government official. It is claimed that with this petrol the danger of fire, both in aviation and in motoring, is almost completely eliminated. In fact, the new fuel is said to have a flash point so low that attempts to set it on fire with a naked flame have been unsuccessful.

Assuming that this fire-proof petrol proves to be thoroughly efficient in service, it appears to offer a solution of many of the problems connected with the operation of aircraft and still more so of airships. The danger of a fire igniting the gas chambers of an airship is one of the greatest operating risks, and the problem of avoiding the danger has always been a very difficult one without having to resort to the use of heavy oil engines. The British Air Ministry are extremely interested in the matter, and are investigating the possibilities of this petrol with a view to its adoption as the standard fuel for the Royal Air Force.

* * * *

From France to the East

The French plans for the establishment of air services to the Far East are rapidly taking shape. A Paris report indicates the intention of the C.I.D.N.A. (Compagnie Internationale de Navigation Aerienne) to extend its existing service to Constantinople overland via Syria to Cairo. Also a new company is stated to be considering a project for a seaplane service from Marseilles to Alexandretta on the Syrian coast and overland to Iraq to link up with the Cairo-Basra British services. This company, in which the French Air Union and the Suez Canal Companies are interested, is considering also an extension of the service overland to China.

If these projected services come into full operation they will provide a direct line from London to Karachi, assuming that the difficulties now preventing the operation of the Basra-Karachi route are overcome in the meantime. Of this service only the London-Paris and Cairo-Karachi sections will be British operated.

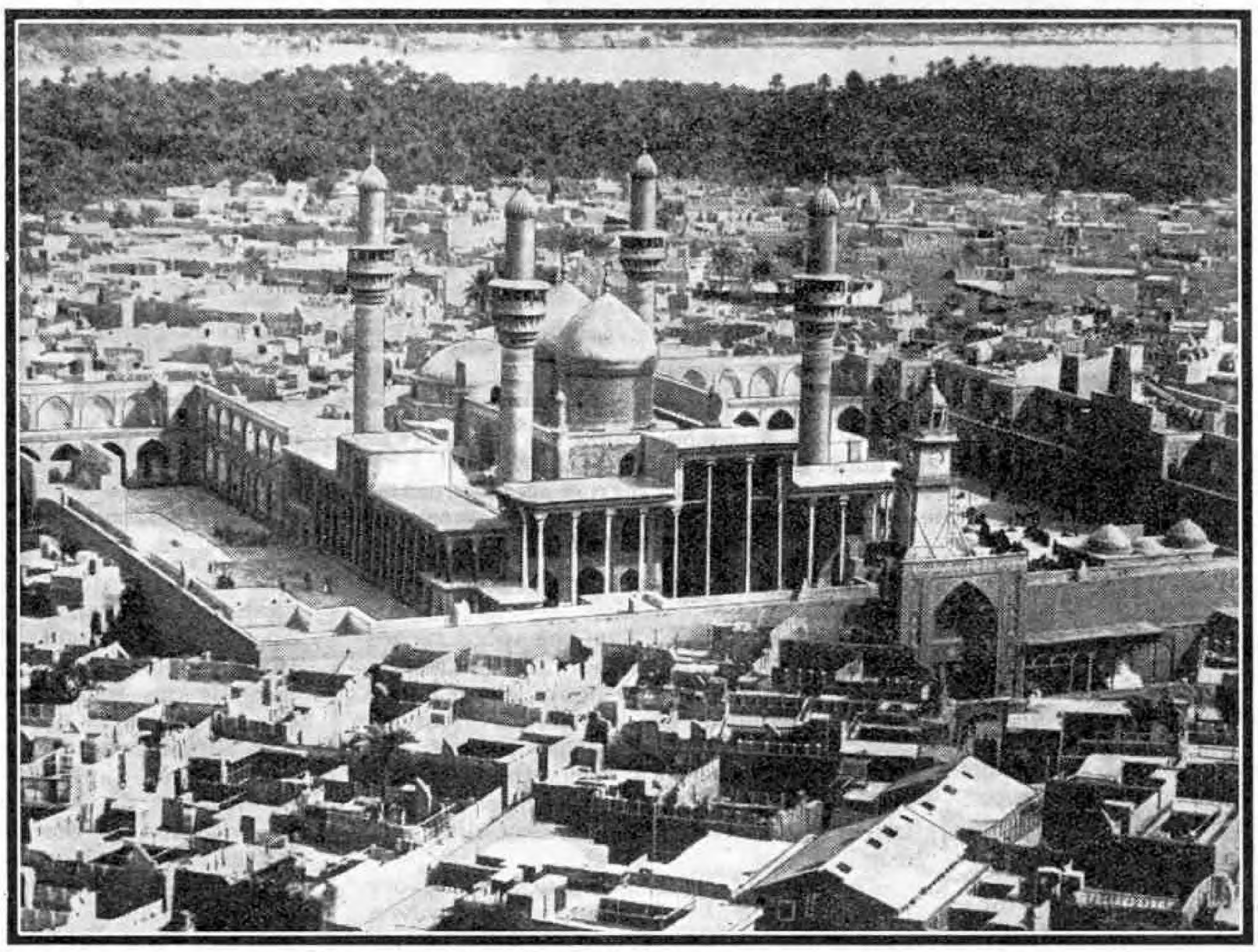
SECOND INSTALMENT

My Flight to India

By Air Vice-Marshall Sir Sefton Brancker, K.C.B., A.E.C.

As mentioned last month, this historic flight to India left England on the 20th November, returning on the 17th March following, and in over four months' active work covered 18,000 miles. During that time they had not a single forced landing through a material defect and the aeroplane totalled over 200 hours in the air. Last month's instalment covered the flight from the start to landing at Constantinople.—EDITOR.

AFTER a very pleasant flight against a head wind, we landed at Konia. Here the aerodrome was almost an hour's drive from the city. The Turkish Air Force had most kindly sent a detachment to help us; they had put up a telephone line from the aerodrome to the town; placed a meteorological officer at our disposal, and provided fuel and oil to meet us on landing. The local Governor invited us to an evening party with Turkish music, and there we met the general officer commanding the local division and the head of an extremely holy sect of dervishes. They wanted to show us everything, and expressed the hope that we could stop at least a week. The hotel was not of the best, and I gathered that most of the bedrooms were very lively. Mine was all right, but Cobham was forced to come and share my accommodation as he simply could not face the crawling population in his own!



The wonderful city of Baghdad, seen from the air

The next morning broke very cold, with low cloud and threatening snow, and as we flew towards Eregli, the weather got worse and worse, with rain, sleet and snow in succession. At one point we seriously considered turning back, but fortunately decided to try for another half-hour, by which time half our petrol would be gone. Then the weather began to clear, and we caught glimpses of a range of high snow-clad mountains on our right and away in front. A quarter of an hour past Eregli we turned south, and made for these mountains. The actual watershed was some considerable distance north of the main line of peaks, and we slipped over it at 5,500 feet, scarcely realizing we had crossed it. On the southern side the country got worse and worse; low clouds came rolling down on the mountains all round, and we were forced to fly down narrow gorges with precipices on either hand and a roaring torrent away down at the bottom. The lower we got, the lower came the clouds, and there were moments when I thought we should have to turn round and try to get back to the top again. Then suddenly we had a glimpse of comparatively flat country, and ten minutes afterwards we were out over the broken foothills of the north of Adana.

We had meant to push on to Aleppo, but the wind was against us, and it became obvious that our fuel would not take us there, so we turned to the south and made for Alexandretta. As we came opposite the mountains that run north from Alexandretta, we encountered a most thorough bumping—evidently an easterly gale was blowing over these mountains and coming down on top of us. Elliott, I, and the baggage began to bounce about the cabin like peas in a tambourine, and personally I only just had time hastily to swallow some seasick mixture to avoid being thoroughly ill. At Alexandretta, the aerodrome is small and close under the mountains, and Cobham had quite a difficult feat to land safely. We encountered a tremendous down current when we were only about 200 feet up, and I thought for a moment we were going to crash.

The hotels of Alexandretta are best left undescribed, but, fortunately, the local British Consul, Mr. Catoni, insisted on entertaining us, and we had thoroughly comfortable quarters.

The next day we started for Aleppo in a high wind and heavy rain. Here the aerodrome proved to be very soft, and it at once became evident that we could not get off without a risk of breaking the propeller with flying stones. The French Flying Corps were splendid, and, whilst they entertained us to an excellent lunch,

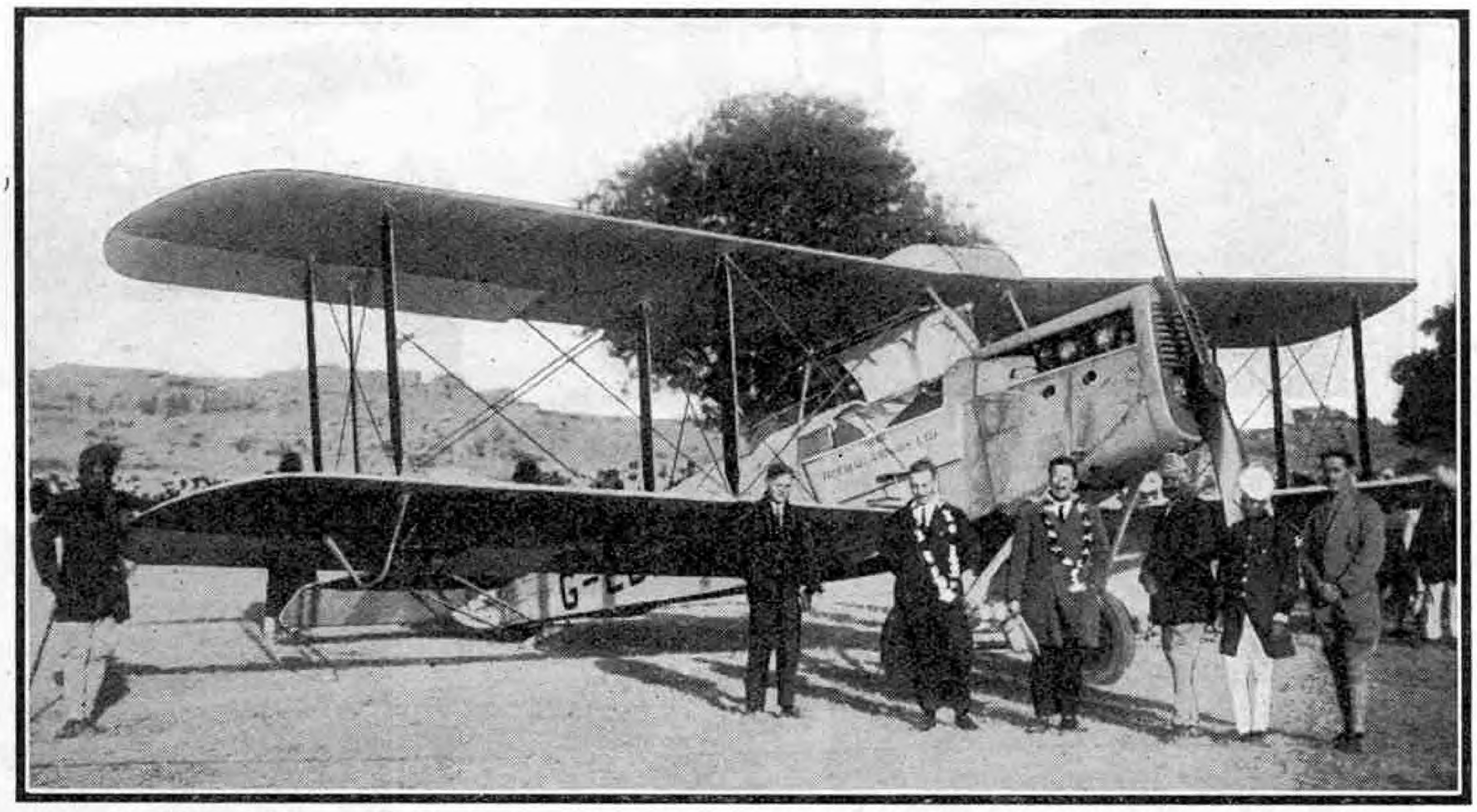
they turned out a detachment and manhandled the machine, fully loaded, across to a hard bit of ground to the north of the aerodrome. It was not until about four o'clock that we managed to get away. It was still raining, and the clouds were right down, so we flew at about 30 feet on a compass course until we struck the Euphrates, where we turned down the river and eventually landed at Rakka, a small French air post at which was stationed one escadrille. Here, again, entertainment was lavish, and we spent a very cheerful evening in the aviation mess.

The next morning we nearly had a disaster. Continuous rain had made the apparently hard aerodrome very treacherous, and, as we taxied out, one of our wheels broke through the surface and we turned gently over on to our nose. Horrible visions rushed up before my eyes! "The propeller must be broken; but we could deal with that as we have a spare propeller. The radiators are probably leaking, the crankshaft is almost certain to be bent." We climbed gloomily out of the machine, and, with the aid of the French mechanics, who rushed up in great excitement, pulled her back on to her tail. The propeller straightened itself out miraculously, and, after looking her round and finding nothing wrong, we decided to run the engine. The propeller wobbled a little, but everything else was perfect, and within half an hour of this contretemps we were up in the air and on our way to Baghdad—a really wonderful testimony to the soundness of British design and construction.

Again we were confronted with a strong head wind, and, as we neared Ramadi, we realized that we could not reach Baghdad in daylight, and so came down at the former aerodrome. The next morning it was raining again, and we went on to Baghdad in very poor visibility. Hinaidi looked terribly muddy from the air, but we managed to land without trouble.

On Christmas Day we left early, intending to lunch at Shaibah, and dine at Ahwaz. I had quite forgotten it was Christmas, and was somewhat astounded as we taxied up to the tarmac at Shaibah to find ourselves greeted by a large crowd of ladies, Turks, negro minstrels, etc. It took me some minutes to realize that the whole of the squadron was in fancy dress to celebrate Christmas Day! After a cheerful Christmas dinner, we started up the engine, but found her running very badly, and after inspection we discovered that the starboard magneto was defective, and had to set to work to put it right. It then became clear that we should not have sufficient daylight to reach Ahwaz, so we decided to stop the night at Shaibah where I had a brain wave that this would be a good opportunity to change our propeller, which was still wobbling after the Rakka incident.

The next morning we started for Ahwaz, but we found that the engine was vibrating very badly, and on reaching Basra we turned round and came back to Shaibah. For ten minutes every one crawled over the machine trying to find out what was wrong, and then suddenly we discovered that our precious new propeller, which we had brought out all the way with us, was slightly split! Evidently during our many hours of flying in bad weather, the driving rain had saturated the fabric cover and got at the propeller tip. So we had to settle down again and put our old propeller back!



Sir Alan Cobham and Sir Sefton Brancker decorated with garlands on their arrival at Datia
H.H. the Maharajah, seen on Sir Sefton Brancker's left, received the aviators on the Parade Ground and a large crowd of natives witnessed the landing

On the morning of the 27th we set out for Bushire, and as we left, we received the cheering intelligence that it was snowing in Baghdad! Again we had a strong head wind, heavy rain and terrible visibility. I do not think I have ever had a more unpleasant flight than that across the huge marshes that lie at the mouth of the Shatt-el-Arab. We could only see two or three hundred yards, and below us was a seemingly unending area of marsh and water channels, from which there would have been no hope of escape if we had had a forced landing. On reaching Bushire we found that the whole place was more or less under water, and we had to land some little way off the main aerodrome. We discovered that we had struck a record year, and that no one had known such a heavy rainfall in the Persian Gulf.

Our departure the next morning was somewhat of an ordeal. Most of the British inhabitants came to see us off. There was a biting cold wind, and Cobham and I had to spend a lot of time in carefully pacing out and reconnoitring the one dry spot in the neighbourhood. However, we made a very good get-off, and set out along the coast through heavy rainstorms. The bad weather lasted right on to Bunder Abbas and the country looked gloomy and desolate to a degree. No inhabitants were visible, and every twenty miles or so there was a roaring torrent coming down from the mountains, completely stopping any form of lateral communication along the coast, which would have rendered a forced landing somewhat unpleasant.

Bunder Abbas has a small and rather sandy aerodrome. The only European house in the place was that of the British Consul, with whom we stopped. The next morning was dead still and rather warm, and the result was that we had considerable difficulty in getting-off at all from the small aerodrome. We made two efforts but the soft sand clung to our wheels and the machine refused to come-off. Fortunately, a breeze sprung up from the south, and, once we had this, all was well.

From Bunder Abbas to Chahbar took us 3¾ hours over a most interesting country. One gets the impression that at some time in the far-distant past the whole of Southern Persia was a sea of boiling mud, and that violent volcanic eruptions threw it into the extraordinary forms that it displays to-day. I have never seen such grotesque mountains in any part of the world, and in places they are wonderfully coloured, presumably from metal deposits. The inhabitants of this section are reported to be extremely treacherous, and very little under the control of the Persian Government. We followed the coast as far as Jask, the British wireless station, and, after passing that unattractive spot, we cut off some distance by flying twenty or thirty miles inland.

At Chahbar we found an excellent aerodrome, about the best on the whole route. Chahbar is a very small place, and the only European living there is the Superintendent of the Indo-European telegraph station, who very kindly accommodated us in his bungalow. From Chahbar on to Karachi the country is not quite so wild and rugged as that which we had already passed over. The flight took us 4½ hours, and towards the end we struck glorious sunshine and beautiful weather. At Karachi we landed on the Royal Air Force aerodrome, and for the first time since leaving England I felt warm.

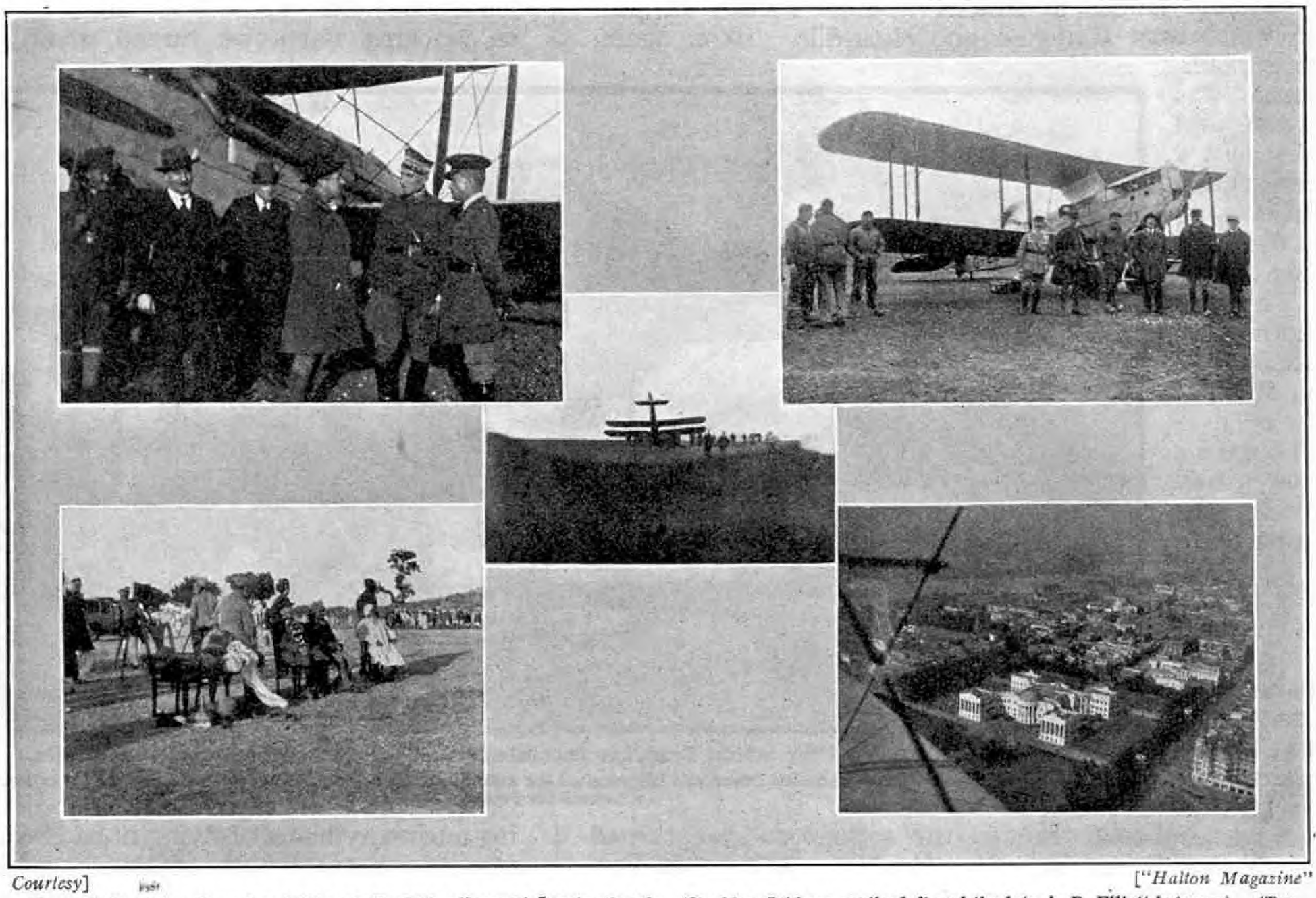
Here we decided that Cobham and Elliott should give the engine a top overhaul, whilst I took the boat to Bombay, where I had to see the local authorities, and then train on to Delhi, where Cobham would pick me up again. After remaining at Karachi for about a week, he flew on and visited Jodhpur and Nazirabad, arriving at Delhi a couple of days after me.

At Jodhpur he found an open space with a huge crowd round it and a band playing, and, just as he was about to land, somewhat amazed at so enthusiastic a welcome, he suddenly saw a pony gallop on to one angle of the open space, and he realized he was alighting in the middle of a polo match! He stopped just in time, and found the real aerodrome.

On the 12th January we flew on to Allahabad, having a look at Cawnpore on the way, and on the 13th arrived at Calcutta, via Benares, after a journey of 6¼ hours. We landed on the racecourse and came to a stop within a few yards of the tree under which Jullerot and I had erected an old Bristol box kite at the end of 1910. We had a most enthusiastic reception, and, although I was very ill, I had to face up to a State dinner at Government House that night, and a meeting with the Chamber of Commerce the next morning. After this I gave up and went sick, to discover that I had pleurisy and pneumonia. I was taken to hospital, where I stopped for just a fortnight, during which time Cobham took the opportunity of flying up over Sikkim towards Kungchentsenga, and having a look at Everest from the distance.

I managed to persuade the medical authorities to let me out of hospital on 1st February, on the condition that I travelled as far as Rangoon by sea. The three days at sea proved a most excellent convalescence, and I was really feeling very fit by the time I got to Rangoon. Cobham arrived three days later, and had to land on the old racecourse, a somewhat cramped area surrounded by trees and buildings. It was pretty obvious that we could not get off it with a full load, so we arranged for him to fly the machine light, over to the new racecourse, where a run in one direction of about 500 yards was possible, and to fill up there before our departure to Calcutta.

When we left Rangoon on 8th February it was already getting very hot and the air was still, with very little lift.



Courtesy ["*Halton Magazine*"

(Top left) Sir Sefton Brancker talking to Turkish officers at Constantinople. (Sir Alan Cobham on the left and the late A. B. Elliott between). (Top right) The departure from Rakka, showing officers of the French escadrille. (Centre) The false start at Rakka. (Bottom left) H.H. the Maharajah of Datia watching some of his ministers joy-riding. (Bottom right) Government House, Calcutta, with the River Hooghly in the background

We had to carry a lot of petrol to make sure of getting to Akyab, and the surface of the new racecourse was none too good. Cobham flew the machine up light from the old racecourse, and then we had to set to work to fill her up with petrol in the blazing sun. By the time we were ready to start, the getting-off conditions were about as bad as they could be, but we just screwed out over the rails and got away, flying unpleasantly close to the tree-tops for some distance. We struck straight across towards the sea, and, once clear of the flat valley of the Irrawaddy, passed over the most beautiful jungle-covered hills I have ever seen anywhere. We struck the coast near Gwa, and then turned north to Akyab. The scenery was magnificent, and, except for the crossing of the Taurus, I enjoyed this stage more than any other.

At Akyab there was quite a good aerodrome, and also excellent sheltered water for the operation of sea-planes. We had glorious weather and a perfect full moon night, but one cannot judge Akyab by its behaviour during February—from June onwards till the end of the summer, I believe the rainfall is over 250 inches. The next day we passed over Chittagong and then west to Calcutta over the northern part of the Sunderabunds.

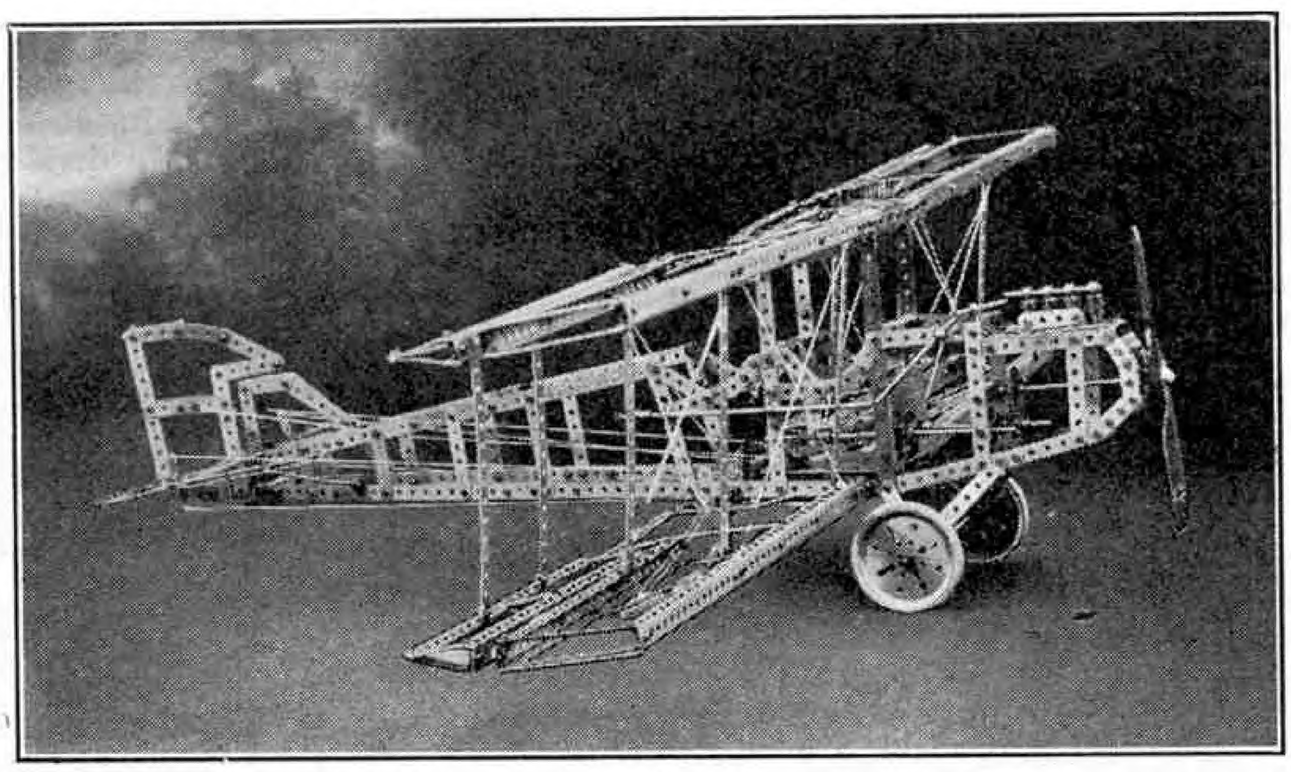
After Chittagong, the flight was somewhat dull, but gave one a vivid impression of the enormous population and agricultural wealth of lower Bengal. Calcutta was now quite hot, and we came to the conclusion that it was not worth risking a take-off from the Maidan fully loaded. The machine was therefore flown light to Dum Dum, where there is quite a big, but very rough, aerodrome.

We had a very interesting flight from Dum Dum on a compass course across the Bengal jungles and landed at Benares, where we had promised to visit the local Maharajah. The only possible landing-place was the garrison parade ground, which was surrounded by high trees, and, as a result, the next morning saw the most exciting take-off of the whole trip. Fortunately for us, a good, strong, bumpy wind blowing from the west lifted us over the trees considerably better than either of us had expected.

We got off with only 1½ hours' petrol, and so we had to land at Allahabad to fill up, in a very high wind and a dust-storm. From there on to Jhansi we had a bumpy passage. I had been quartered at Jhansi in the old days, and it was most interesting to fly over all my old pig-sticking and shooting haunts. We landed on Jhansi aerodrome, but found that the Maharajah of Datia, who lives about twenty miles to the north, had prepared a special ground for us, and was expecting us there, so we got off at once and landed just outside the Palace at Datia before a huge crowd of local inhabitants, practically none of whom had ever seen an aeroplane before. The indefatigable Cobham then proceeded to give joy-rides to various royal princes, members of government, etc.

The Maharajah was most hospitable and wanted us to stay for as long as possible, offering us shooting of every description. But time was flying, and my unfortunate illness had delayed us for practically a month, so we had to push on after taking only one day off to look round the old city and palaces.

Interesting Model of a D.H. "Moth"



This Meccano model of the famous de Havilland Type 60 "Moth" Aeroplane secured First Prize for T. R. Thompson, of Ramsgate, in a recent Meccano Model-building Competition. It is an excellent example of Meccano construction and is not only built to scale, but includes most of the necessary mechanical details. The propeller is driven from a Clockwork Motor built into the floor of the fuselage beneath the forward cockpit, with its winding spindle projecting beneath the aeroplane. The 3" Pulley Wheels with Rubber Rings are mounted loosely on an 8" Rod, the supporting Strips being splayed to the required position.

One of the most interesting features of the model is the realistic reproduction of the de Havilland patent differential aileron control. In actual practice this device has been evolved to obtain better and easier lateral control of an aeroplane at all speeds, especially round about stalling speed.

Spinning Tops that Steer Ships—

(*Continued from page* 241)

north, and during alterations of course, the spider, being secured to the ship's frame, with the ship moves round the gyro. But if we were down in the gyro compartment, unable to see land or sea or sky, we should be unaware when the ship happened to alter course, except that we should suddenly see the gyro, as it appeared to us, without warning set itself in a new direction.

In conclusion, one more point may be mentioned. The magnetic compass has proved most unreliable in aircraft because their rapid acceleration, dipping and rolling, and the metal of their engines—which needs must be within a few feet of the compass—cause wild swingings and oscillations of the card and create large and varying deviations. A gravity-controlled gyro-compass is also unsuitable, because this same acceleration, dipping and rolling causes the weight to lag behind and thus set up incorrect precession. Experiments are being carried out to produce a gyro so nearly perfectly free that the little friction remaining will only cause it to wander from the meridian very slowly, and at a fixed rate which, for some hours at any rate, can be calculated and allowed for.

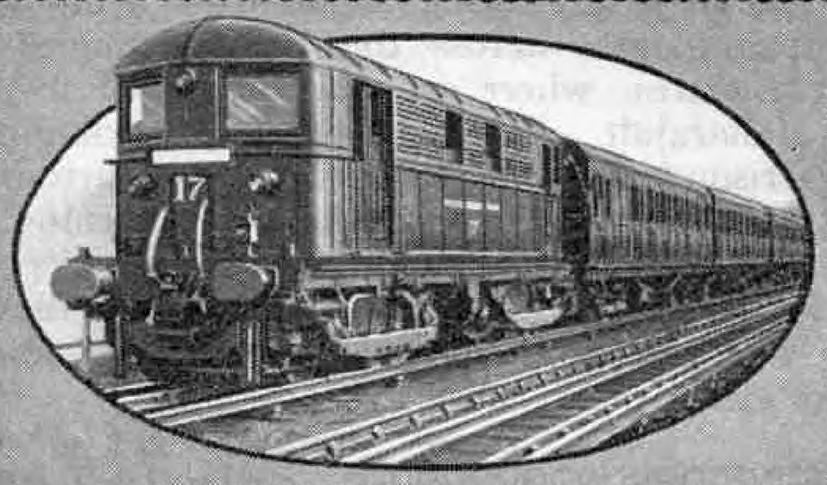
Mapping Alaska from the Air—

(*Continued from page* 233)

with ice cut out of small bergs from the Taku glacier.

As already stated, the expedition was in the field four months and constituted the largest aerial survey yet made by the air service of a government. Apart from the actual mapping of much hitherto unknown territory, hundreds of oblique views were made for the Lighthouse Service; for the Forest Department, to enable it to determine the quality, quantity and type of timber; for the Roads Department; and for the Bureau of Fisheries, which desired photographs of its hatcheries and contiguous lakes and streams.

This Alaskan survey is a striking object lesson of the use to which military aeroplanes may be put in time of peace for the benefit of the country and the people generally. All told, the machines covered 50,000 miles, equivalent to twice around the globe at the Equator.



A METROPOLITAN TRAIN

RAILWAY NEWS

World's Oldest Railway Electrified

The announcement that the Swansea and Mumbles Railway is being electrified recalls that this line, 5.38 miles in length, can claim to be the world's oldest railway. Although certain older "tramways" existed prior to its opening in the reign of George III, they have since become defunct, whereas the S. & M. line has been in existence since 29th June, 1804. It was not until 1870 that the original horse-traction gave way to steam, when small engines of the totally enclosed "tram" type were used. These, in turn, were superseded in 1892 by larger saddle-tank locos. The Swansea Tramways Company exercised running powers over the line while their vehicles were still horse-drawn, and as under the terms of the agreement the horse cars had to arrive at the Oystermouth Terminus within three minutes of the steam trains, the poor old "gee-gees" had to get a move on, especially as the engines averaged more than 10 m.p.h.!

The old rolling-stock consisted of double-deck vehicles of tramway type, and large numbers of passengers were carried during the summer months.

The new rolling stock will comprise 11 coaches of the bogie type, having complete electrical equipment of the latest design, both for power and for braking. Two powerful electric motors will propel each coach, the control equipment being so arranged that a train may consist of one or two coaches as required, and be driven from either end. Safety devices include the incorporation of the "Dead Man's Handle" controller in the driver's cab. Current is to be collected from an overhead cable. R.S.M.

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Continuous Brakes for French Goods Trains

Proposals are on foot for the installation of continuous braking apparatus on all French goods trains. Nearly 525,000 wagons are to be equipped and it is estimated that the approximate cost will be 1,600 million francs (£13,000,000). Germany is to supply half of the material required as part of her payments to France under the War Reparations Scheme. The other half will be ordered from French manufacturers.

This scheme will take some six years to complete and it is on these grounds that the French Commission of Finance have recommended that the time in which the French Railways must obey the compulsory order for the adoption of automatic couplings for goods trains should be extended until 1938. The adoption of automatic couplings can only follow the fitting of continuous brakes and, incidentally, the postponement will enable the trials of the three French types of couplings to be completed.

"River" Tanks on the Road Again

The Southern Railway have now restored the "River" class tank locomotives to regular service. Readers will recall that all the engines of this class were withdrawn pending the inquiry into the Sevenoaks disaster, when an express train drawn by one of the "River" class engines left the rails while travelling at 57 m.p.h. The outcome of the inquiry was that no blame attached to the engine, although a tendency to roll when rounding curves at high speeds was disclosed in the evidence. The roll is due to the motion of the water in the tanks.

* * * *

New Type American Locomotive

Recently there have been introduced on the New York Central and Michigan Central line of the New York Central Railroad 60 new locomotives, known as the "Hudson" type, for long-distance passenger services. The engines are 95 ft. 11 in. in length and develop a maximum of 3,500 h.p. on the drawbar at 66 miles an hour. This represents an increase in power of 75 per cent. as compared with the Pacific engines that the new type is to replace. The length of the Pacifics is 78 ft. 2 in.

The designers, in considering this new type of engine, had rather a big problem before them. They had to produce a more powerful engine than existing types, and to haul heavy trains in all conditions of weather against very strict schedules. But it was also required that the driving wheels should carry a lighter load than the Pacific type in order to diminish wear and tear on tracks. The problem was solved by adding a pair of wheels to the trailing truck of the Pacific type and generally re-distributing the load.

* * * *

A Famous L.M.S. Landmark

Passengers travelling to the north of England by the L.M.S. West Coast route probably often have been puzzled to know why an apparently ordinary tree, some nine miles south of Carlisle and close to the line, should be surrounded with a brick bastion.

The legend runs that before the line was constructed the owner of the land that it was to cross went over the ground with a railway surveyor. At a certain point the owner stuck his walking stick into the ground as a temporary mark and absent-mindedly forgot all about it. A few weeks later, on returning to the spot, he was astounded to find his stick had taken root, and immediately he introduced a clause into the agreement for the sale of the land, requiring the Railway Company to preserve for ever his trusty staff!

L.N.E.R. to Employ Steam Coaches

The L.N.E.R., after considerable experiment with improved steam rail coaches, have decided to meet the need for more intensive passenger services on some parts of their system by extending the use of these handy little trains. Both the Sentinel-Cammell and, more recently, the Clayton types of rail car, have been under tests, and orders have been passed for 20 of the Sentinel-Cammell type and four Super-Sentinel locomotives. The purchase of 30 other coaches either of the Sentinel-Cammell or of the Clayton type is in contemplation, but this has been deferred for further experience of certain mechanical improvements.

The new steam rail coaches will be used principally in the North of England industrial districts, but their use is anticipated on branch lines in other districts also, and particularly where road competition is being acutely felt.

* * * *

Manchester Railway Electrifications

As an experiment it is proposed to electrify the joint L.N.E.R. and L.M.S.R. Manchester South Junction and Altrincham Railway. Bearing in mind the extremely satisfactory response to the intensification of the steam service on this branch line some months ago, and the developments that followed the electrification of the Liverpool suburban lines of the old L. & Y. Railway, there seems little doubt that the experiment will prove successful and that ere long all the Manchester suburban lines will be electrically operated.

* * * *

L.N.E.R. Tunnels to be Opened

Owing to the pressure of traffic and the consequent need for a four-line track on the busy L.N.E.R. section between Godley and Mottram Stations on the old G.C. line near Manchester, it has been decided to open up two tunnels on the section. These are 100 yds. and 264 yds. in length respectively and are joined by a cutting 110 yds. in length. The task of converting the complete stretch into one cutting involves the removal of over 700,000 cu. yds. of soil. The Stockport-Glossop road crosses one of the tunnels and a five-span viaduct of brickwork and steel will be built to carry this over the new cutting.

* * * *

Euston Station Re-decorated

The largest waiting room in Great Britain, the great hall at Euston Station, has recently been re-decorated in accordance with a design prepared by Sir Edward Lutyens, the famous architect. The work has been carried out entirely by the L.M.S. staff and over 5,000 lb. of paint was required to complete the work.

Iraq Railways

Brigadier-General F. G. Hammond, who has been conducting an inquiry into the management, finance and working of the Iraq Railways, has just issued his report. He states that the existing railways of the country consist of some 810 miles of track, of which 624 are metre gauge and the remainder standard. Before the War the only railway in the country was a 74-mile stretch of standard track from Baghdad to Samarrah. This was part of the famous German Baghdad Railway, a line that was never completed. During the War the British Forces extended the line for military purposes a further 112 miles north to Sharqat on the Tigris.

The most important track built during the War was a metre gauge connection between the Port of Basra and Baghdad and Kirkuk. Further stretches of this line have been built since then and General Hammond now suggests that the line should be extended from Kirkuk to Mosul, 100 miles farther on. Mosul is only 70 miles north of Sharqat, but the intervening stretch between the two cities is desert land. The opening of a connection to Mosul from Kirkuk will open up the most fertile area in the whole of Iraq.

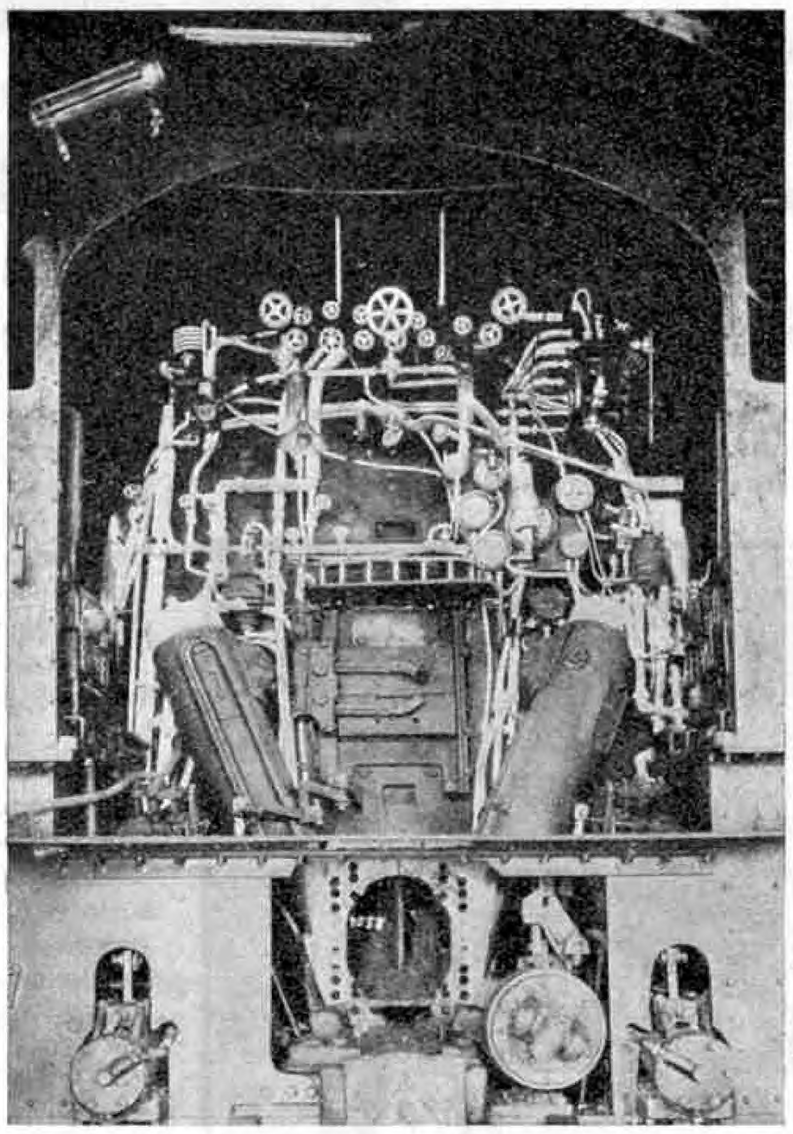
The standard gauge line between Samarrah and Sharqat is to be pulled up and the rails used on the new extension, and the remaining section of the line from Baghdad to Samarrah, the old pre-war stretch is to be converted from standard to metre gauge.

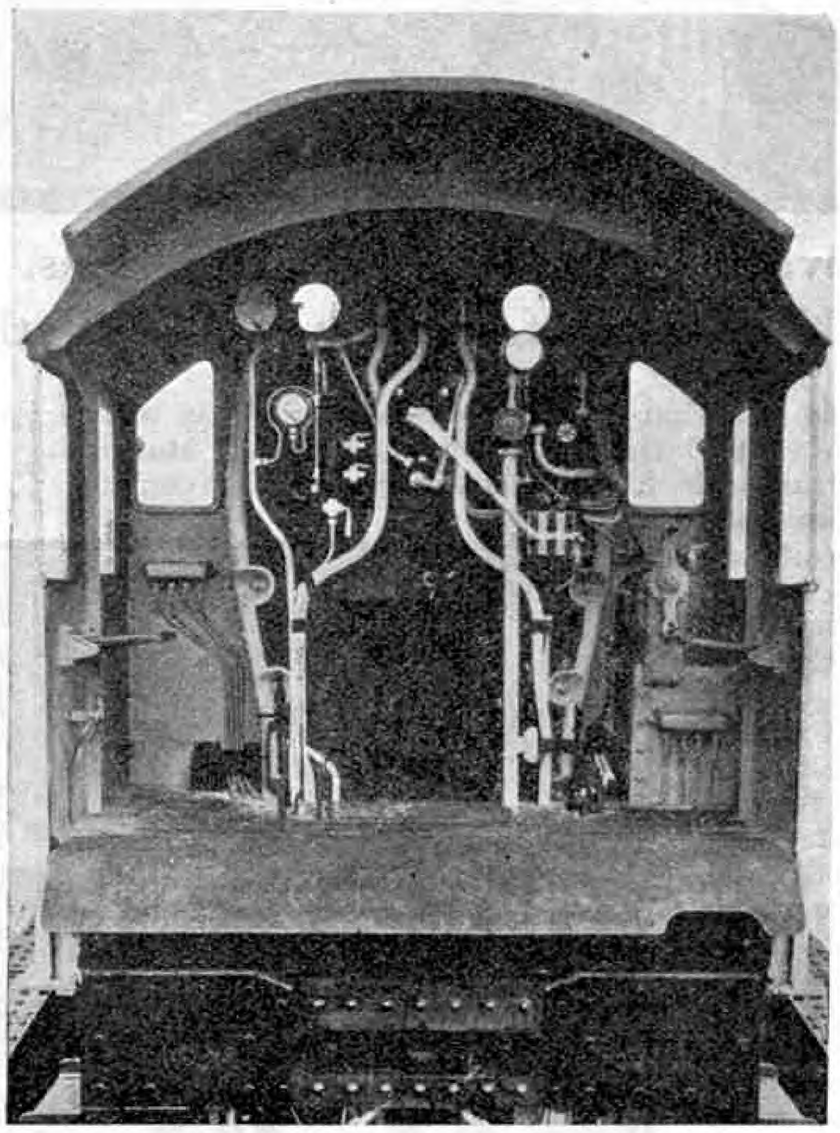
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New French Electric Engines

The most powerful electric locomotives in Europe are stated to be two express engines recently delivered to the Paris-Orleans Railway. They have been designed to handle the Paris Vierzon express passenger service, the trains on which often attain a weight of 650 tons.

The locomotives are of the 4–8–4 type and receive their power from an overhead line and also from a third rail at 1,500 volts. At this pressure an hour-rating of 4,000 h.p. is secured. Each locomotive weighs 119 tons and conforms to a specification requiring it to attain a speed of 130 km. per hour on suitable track, with ability to negotiate at low speeds curves having a radius of 80 metres. These conditions necessitated the use of two-axle bogies fitted with a spring centring device on each engine.





The two photographs above, published by the courtesy of the G.W. Railway, illustrate in a striking manner the different cab fittings. The photograph on the left shows the cab of one of the latest locomotives in use on the Atchison and Santa Fé, and that on the right shows the cab of a G.W. " Castle " locomotive, which is simple in comparison with its American cousin

Underground Railway Train Recorder

On no British railway is the saying " Time is Money " more clearly understood than on the Underground Electric Railways, and in the past our columns have recorded the introduction of device after device designed to speed up the traffic.

The newest idea works in an indirect manner and serves the dual purpose of preparing a daily record of operations on each of the lines and indicating to every depot the existence of a stoppage on any part of the system. The apparatus consists of a group of six 24-hour clocks, one each for the District, City, Central London, Bakerloo, Piccadilly, and Hampstead lines. The clock faces consist of paper dials that rotate and make a complete circuit of the face in exactly 24 hours. The clocks have no hands, and are connected up with the Tube Railways control office at Leicester Square and the District Railway control office at Earls Court. As each train passes a fixed point, electrical contact is made with the clocks and a small inked hammer taps the dial, leaving a clear record of the exact moment of contact. Thus, as the day passes it is possible to observe whether the regular time interval schedule is being maintained or whether delay is occurring. In the latter case gaps appear between the markings but the clock does not record the nature of the occurrence causing delay.

A further instrument is to be installed along with the clocks at all engineering and operating depots. This will indicate the precise nature of the delay, where it is arising and what steps are necessary to overcome the trouble.

* * * *

To identify the old Wembley Exhibition Station more closely with events held at the Stadium, the L.N.E.R. have changed the name of the station to Wembley Station.

L.M.S. Signal Changes

The familiar signals on the L.M.S. Railway will shortly disappear from view for an important change is about to be made. At present the signals in use are of what is known as the lower quadrant type and it has been decided to replace these by the upper quadrant type, recommended by the Railway Executive Committee in 1919.

The upper quadrant signal undoubtedly has certain advantages over the existing type. In both types the signal lies in the horizontal position to indicate " danger," but whereas in the old type the arm falls to indicate " Clear," the arm of the upper quadrant signal rises to an angle of 55 degrees from the vertical. This raised position of the arm is regarded as giving a more unmistakable indication and it has a further advantage that the arm is carried away from any possible confusion with other items on the track. If anything should occur to throw the signal arm out of order it would automatically fall to the horizontal " Danger " position. In the lower quadrant type, in order to prevent a faulty signal from dropping to " Clear " it is necessary to introduce heavy spectacle glasses to balance the weight of the arm. The change to the upper quadrant type will necessarily occupy considerable time but the fact that the horizontal arm in both conveys the same indication will prevent any confusion arising from the simultaneous use of the two types.

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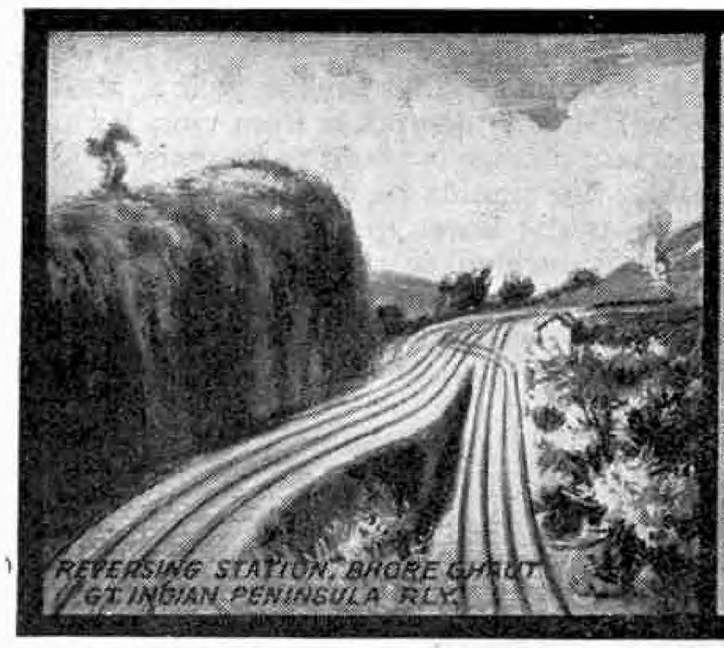
Articulated Engines for New Zealand

The North Island Main Trunk Railway of New Zealand have recently invited tenders from British firms for the supply of three articulated locomotives of a tractive power of not less than 40,000 lb. and having driving wheels ranging between 4 ft. 9 in. and 5 ft. in diameter. The approximate length is to be about 60 ft. The engines under consideration are of the Garratt and Modified Fairlie types, both of which designs are familiar to our readers.

It is proposed to employ the new engines over the heavy mountain grades that at places touch 1 in 50. On heavy going such as this a Garratt engine of the specified tractive effort would be capable of drawing approximately 6,000 tons at a speed of 10 m.p.h.

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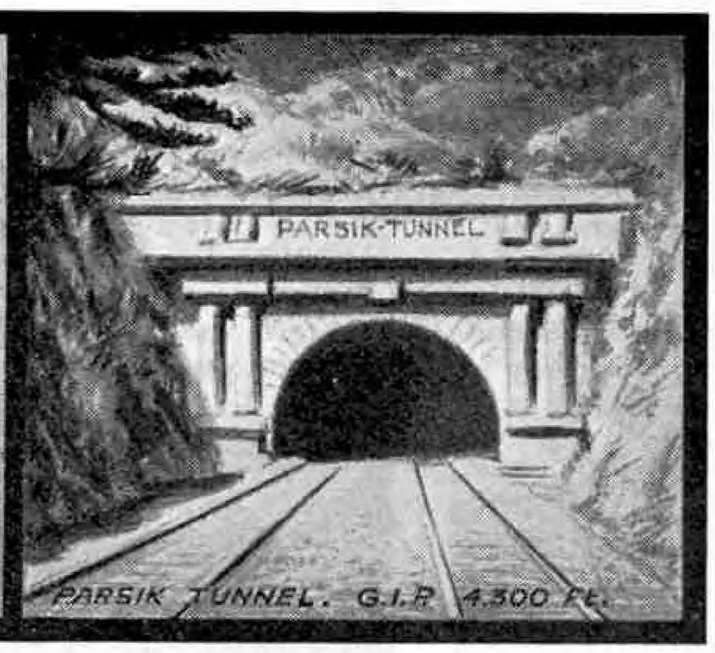
The " Royal Scot " 4–6–0 engines of the L.M.S. Railway are classified as " 6 " in the power classification schedules.



MY TOUR ROUND THE WORLD

by

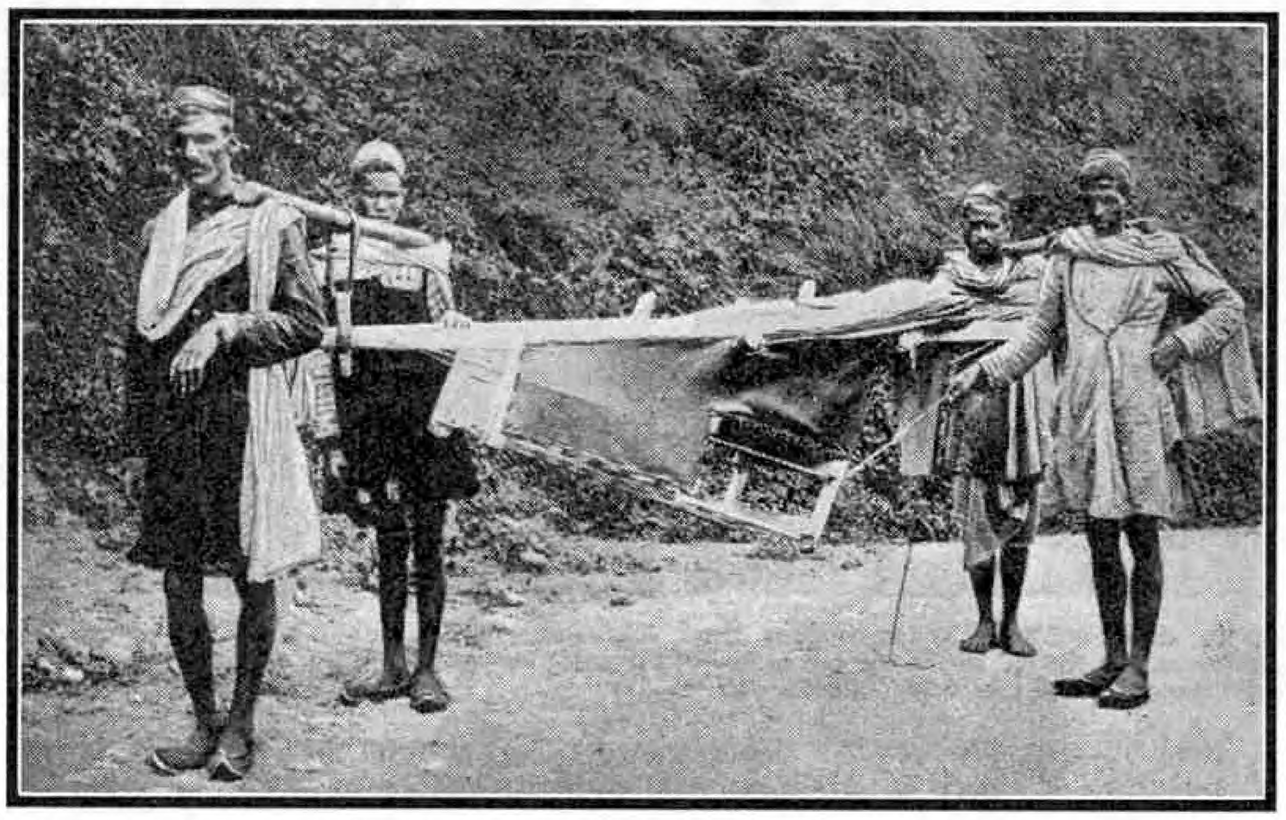
FRANK HORNBY



VIII. Above the Clouds in the Himalayas. The Rich Plains of the Ganges Valley. Benares, the Holy City of the Hindus. Bathing in the Sacred River. The Taj Mahal.

LAST month I told you that I left Calcutta on the day after my arrival to visit Darjeeling. This famous hill station is 20 hours' train ride from Calcutta, and is a favourite resort of the European inhabitants of this city in the hot weather, as its mean temperature is 24°F. lower and the air drier and more invigorating.

The regular train took me to a place called Sillicuri, where I changed to the Himalayan Mountain train, which is very small and runs on a 2 ft. gauge track. The route lay through dense forests in which were an abundance of big game, and from the commencement of the journey it commenced to climb steep ascents. During the trip there were many difficult gradients to deal with, for Darjeeling is 7,167 ft. above sea level, and it was interesting to see how the engineers who had constructed the line had got over these difficulties. In several places it was necessary for the train to rise about 30 feet within a distance of little more than its own length, and this was accomplished by moving backward and forward up short inclines until the desired height was reached. In other cases it ran under a tunnel on to a small projecting promontory at the side of the mountain, and returned over the tunnel by which it had entered. In this way the train turned and twisted and puffed and struggled like some living animal determined not to be beaten in its attempt to reach the top. Seven hours were occupied in making the ascent.



The hill "dhandi" used in place of wheeled vehicles on the steep roads around Darjeeling

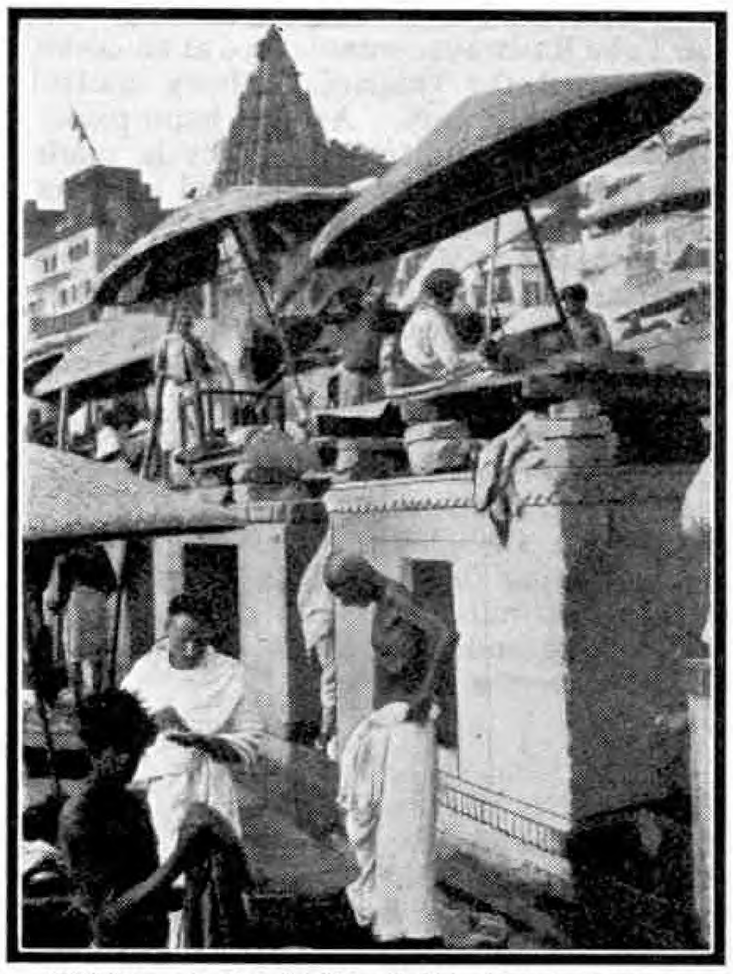
Darjeeling, being built on the side of a mountain, presents many difficulties for vehicles and pedestrians owing to the steepness of the roads. To reach the hotel from the station it was necessary to make a zigzag climb of nearly 100 feet, and the rickshaw that conveyed me there required four men to negotiate the steep gradients. The coolies, who do most of the work, are Thibetans, and look very wild and barbaric in the dress covered with ornaments that they are accustomed to wear.

After dinner on the evening of our arrival, a performance was given by a troop of natives in the main hall of the hotel. Their instruments consisted of a drum and a pair of cymbals, and with them they made the most barbaric sounds it was possible to imagine. Some of them wore fantastic dresses and had over their faces flat ugly masks that were suggestive of grotesque animals. They danced around the room singing their native folk songs. Apart from the novelty of this performance there was very little in it to commend itself to visitors.

One of the most important objects in visiting Darjeeling is to see the sun rise over the Himalayan Mountains, and to obtain, when conditions are favourable, a view of Mount Everest 100 miles away. I made arrangements with the hotel proprietor to accompany a party on the following morning for this purpose. The start was made at 3.30 a.m., and on emerging from the hotel in the darkness of the morning, I found about 100 Thibetan coolies, who looked more like a gang of bandits than an escort, and a number of ponies and dhandies waiting to convey us. The dhandi is a litter in which the passenger is borne on the shoulders of four coolies. Wheeled vehicles are, of course, quite impossible on the steep ascents necessary on such excursions as this.

I decided to ride a pony and, after everyone had been accommodated, the party moved off. When we had proceeded some little distance up the steep and winding road I looked down at Darjeeling, and the twinkling lights in the darkness and the clouds further below covering vast valleys made a weird picture. As we proceeded further on our journey the party became scattered until I found myself travelling alone, and as we got further away from Darjeeling the darkness became more accentuated. Not knowing the direction, I was absolutely dependent on the ability of the pony to find the way. It was almost impossible to see the path along which I was travelling, but presuming that my pony had made the ascent many times before, I felt somewhat satisfied that the course it took was the right one, and I therefore abandoned any control over it. At times it walked so very close to the edge of the road, over which I felt might be a steep abyss, that I became a little apprehensive of danger, and it was a welcome relief to me whenever I was able to discern banks on either side of me.

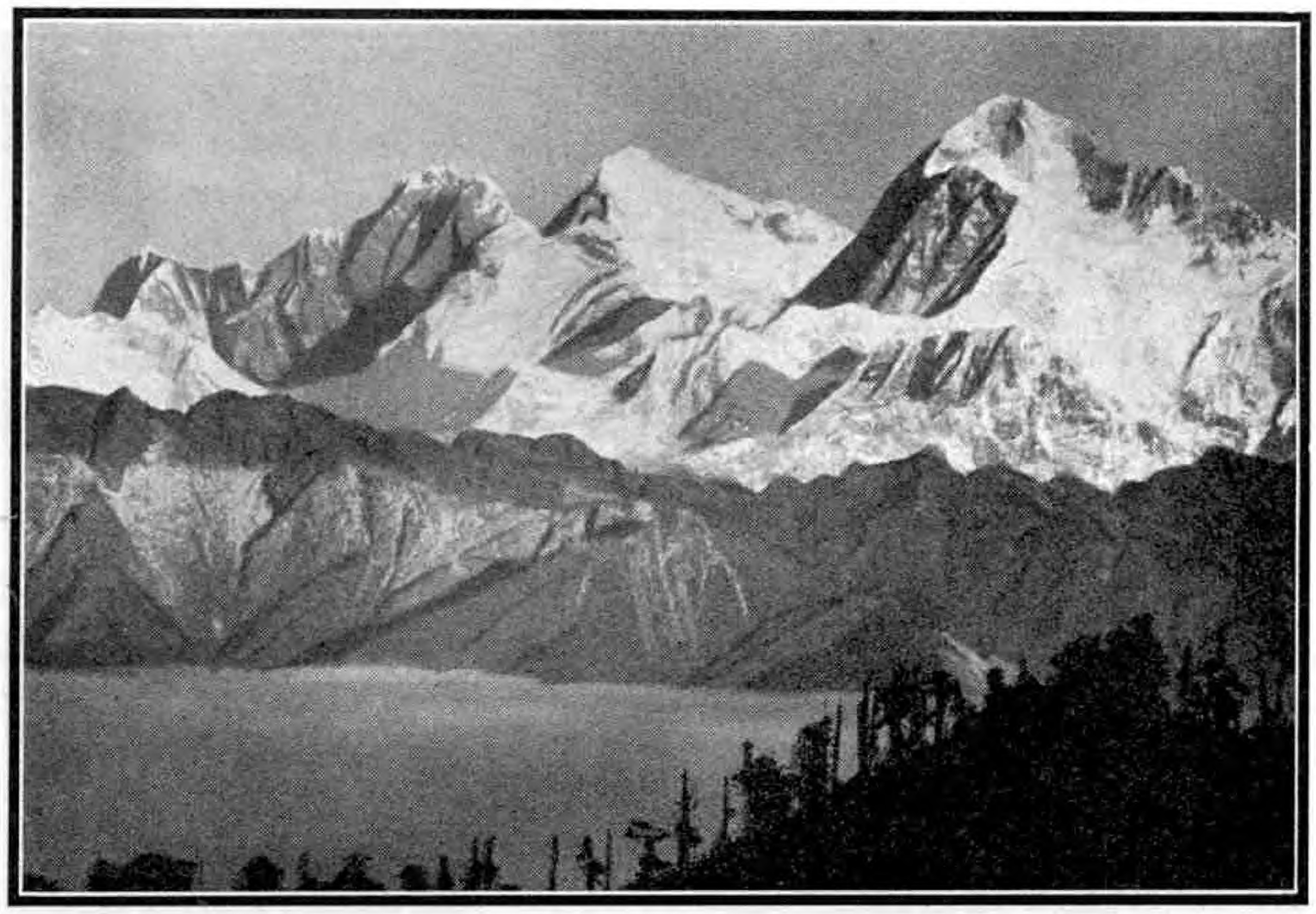
The place chosen to give the best view of the sunrise was Tiger Hill, the summit of which was 1,000 ft. above Darjeeling and seven miles distant. I succeeded in reaching my destination before the dawn, and fortunately, as it seemed to me in the darkness, without any mishap.



Pilgrims on the banks of the sacred Ganges

As the dawn broke, the gigantic snow-clad mountains loomed out above the clouds. The first to make its appearance was Mount Kinchinjunga, 40 miles away. This mountain is only 1,000 feet less in height than Mount Everest. The sun was still invisible to us although it was shining from behind other mountains upon the peak as it towered above the clouds in the valley.

After this many other mountains disclosed themselves, and finally the crest of the unconquered giant, Mount Everest, 100 miles away, became visible. We were fortunate in seeing this, as it frequently happens that clouds obscure the view and disappoint those who have made the early morning journey. Shortly afterward the sun appeared from behind the clouds covering the valley, and a most gorgeous spectacle was presented. The gigantic sunlit mountains rising out of the clouds were visible as far as the eye could see, and the veneration of the Hindus, who regard the Himalayas as the roof of the world, became quite comprehensible.



Mt. Everest and other peaks of the Himalayas rising above the valley mists. The distant point in the centre is 29,000 ft. in height

Returning to the hotel by the way I had come, I was able to see in broad daylight the dangerous paths I had travelled in the darkness. The sight of the appalling descents confirmed my previous uneasy feelings and I could not help being extremely thankful that no accident had befallen me.

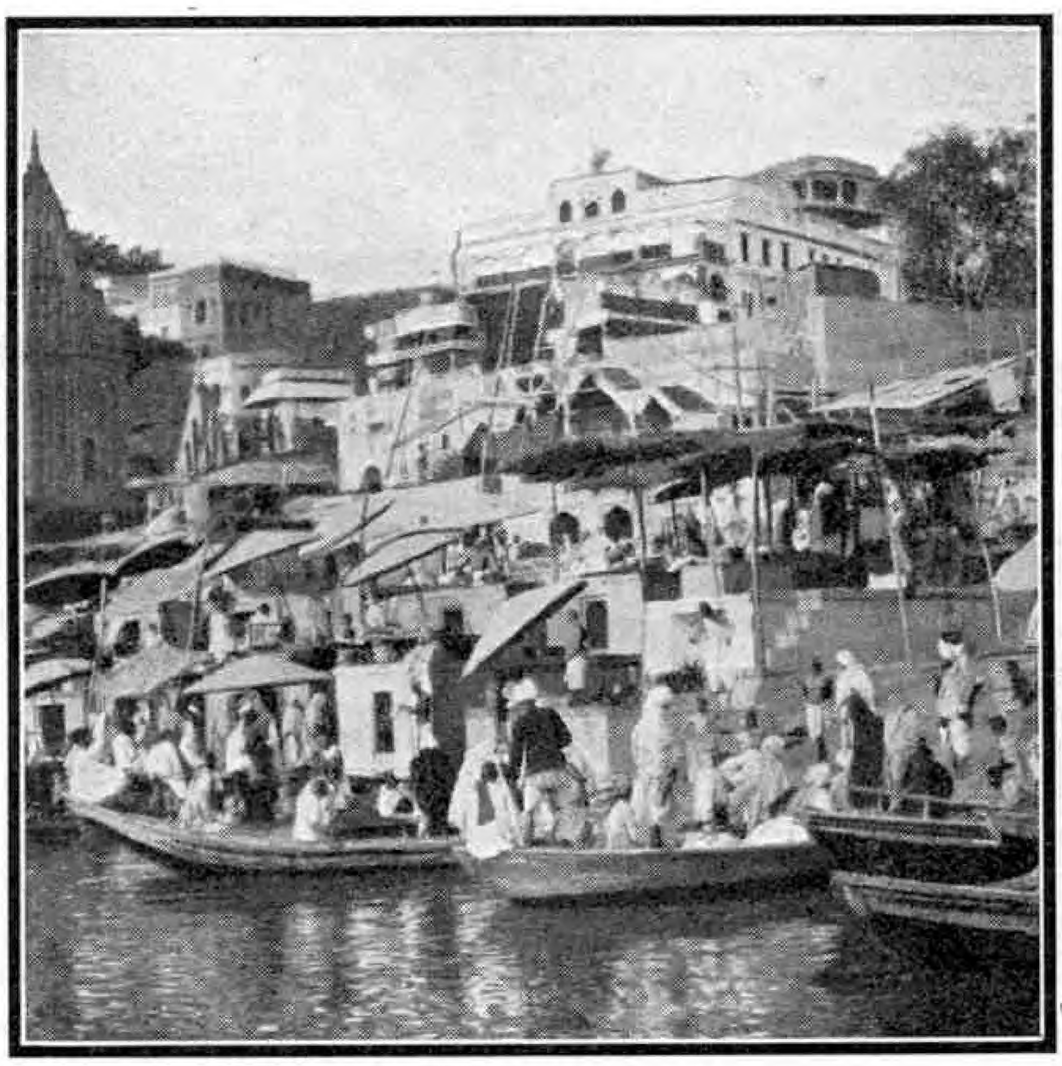
From Darjeeling I returned to Calcutta once more and there commenced a journey across India in which I designed to visit first the important historical cities in the valley of the Ganges and then to proceed through the famous native states of Rajputana to Bombay.

Benares was the first place I visited after leaving Calcutta. This remarkable city is the holiest place on earth to millions of Hindus and it is supposed by them that the ground on which it is built was created before the rest of the world. They believe that the limits of the city were fixed by the god Siva himself on the north bank of the Ganges between its junctions with two tributaries, the Assi and the Barani. I discovered during my tour that the junction of two rivers is always regarded by the Hindus as sacred, while the Ganges itself is to them pre-eminently a holy stream.

Ever since its foundation Benares has been specially venerated by religious Hindus who express their feelings in various ways. It is considered the duty of every wealthy Hindu to erect at least one shrine somewhere within it, while the less fortunate individuals who are unable to do this consider no sacrifice too great that enables them to make a pilgrimage to Benares in order to bathe in the waters of the sacred river. As a result the "Cathedral City" of Hindu religion has 2,000 temples and innumerable shrines, while the low cliff that forms the north bank of the river is lined with many sacred buildings. Steps lead down to landing places that are practically continuous and these are almost always crowded with Brahmins, Fakirs and bathers.

I took a boat early one morning and passed down the river to see the ghats, as the landing places are called, and the religious ceremonies of the devout Hindus already assembled there. There were many thousands bathing, some from the steps and others from crudely erected platforms, and the religious fervour with which they performed their ablutions was very impressive. Bathing is a religious rite, not an amusement, and there was practically no noise. Each bather stepped slowly and carefully into the water, dipped his head in the stream and even drank the muddy liquid.

To western eyes the last seems a particularly dangerous thing to do, for to drink unboiled water in India is always regarded as the height of imprudence and the Ganges hereabouts is polluted in many ways. For centuries, however, the Hindus have been convinced that no harm could possibly come to them from the water of their wonderful river as it flows through Benares, and there seems some ground for believing that the water actually contains a purifying agent of some kind that is specially deadly to the germs of cholera, the dreaded disease that has so often devastated Asiatic countries.



The crowded bathing Ghats of Benares

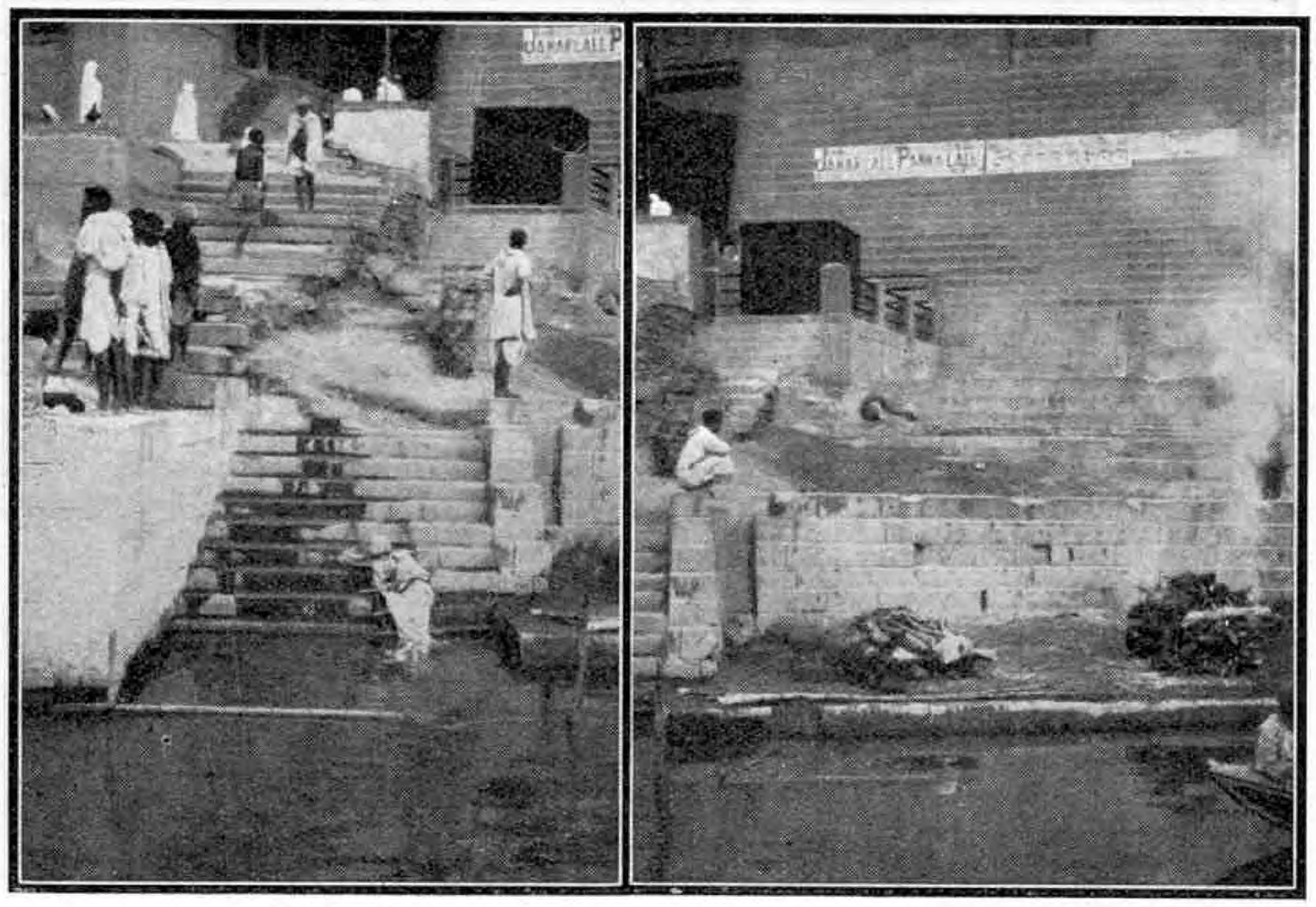
Many of the temples and buildings devoted to religious ceremonies are situated along the banks. Even Rajahs have built palaces and temples there so that they might be represented at the sacred river.

I have already remarked that it is the wish of every devout Hindu to make a pilgrimage to Benares in order to bathe in the Ganges, but even more does he desire to breathe his last within sight of the sacred river. Like many other orientals he believes in reincarnation, or return to life on earth in human or possibly animal form. There is practically only one way in which he may hope to break through the eternal round of re-births and deaths, and that is to die in Benares. The dying are brought to the ghats and there, in little stone huts or on the open steps, they await their end, convinced that they will not return to the earth to struggle through life again. A terrible fate, however, awaits those who by some mischance die on that part of the opposite bank known as Vyas Kasi. This was the site of an attempt to found a rival city and a being unfortunate enough to die there returns to the earth again in the form of an ass!

As I proceeded up the river past the ghats with their silent crowds of bathers I came to one where the brown earth of the river bank showed. This is practically the only place in Benares where the river bank is not covered with steps and buildings. It is the Manikarnika Ghat, commonly referred to by visitors

as the " Burning Ghat." After the religious portion of the final ceremony has been performed, the body is suitably wrapped and immersed in the river, after which it is allowed to remain for an hour or two before being placed on a pyre of wood to be burned. At the completion, the ashes are cast into the river.

In Benares itself the streets are very narrow and winding, as is not unusual in ancient cities. Benares really is ancient, for it was already famous 2,500 years ago, and the Hindu tradition that it was the first place created is further testimony of its antiquity. I have already remarked that it is full of temples and shrines. The most remarkable of these is the Golden Temple, the holiest spot in the city. It is the special shrine of Siva, the patron god of Benares, but is a comparatively modern erection built to replace an older temple that was pulled down to make room for a mosque when Mohammedan rulers conquered India.



The famous Manikarnika Ghat in Benares where the bodies of the dead are burned. In the left-hand photograph the body in its shroud is on the steps, partially immersed in the river. On the right it is seen burning on its pyre of wood

It was impossible for me to visit all the sacred places of Benares but I found the Durga Temple interesting. This shrine has been nicknamed the Monkey Temple because it is infested with crowds of these mischievous animals. It is the only temple in the city where blood sacrifices are still made, a goat being slaughtered daily.

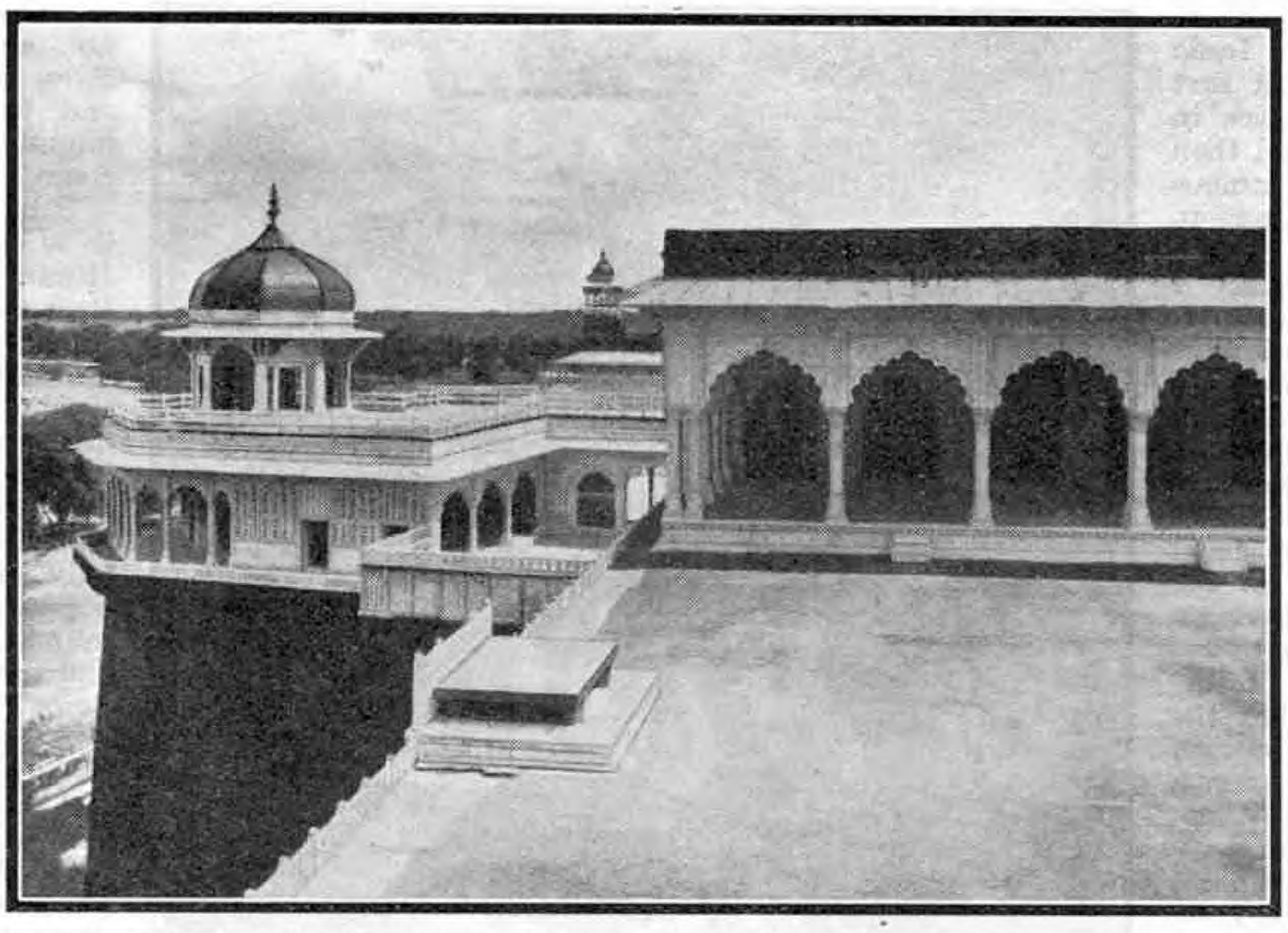
After Benares I visited Lucknow, a place that will always be remembered in connection with the Indian Mutiny. I visited the Residency, now in ruins, and many other places that became famous during the siege. When the outbreak occurred, the Governor, Sir Henry Lawrence, had only a handful of British and loyal native soldiers with whom to defend his position against thousands of sepoys. He had foreseen the approaching storm, however, and had provisioned the Residency in preparation for a siege.

The story of the heroic efforts made during the weeks that followed has often been told. The moral effect of the successful resistance was tremendous, for it was the only spot in the entire kingdom of Oudh, of which it was the capital, that remained in the possession of the British at that time. As everybody knows, the garrison was relieved by the troops under Havelock and Outram, who in their turn were beleaguered until a new force under Sir Colin Campbell finally rescued the garrison and placed them in safety in a fortified camp a few miles away. Even after that exciting scenes were witnessed, for when the British troops returned after securing Cawnpore they besieged the mutineers in Lucknow. A handful of British soldiers had defended a weak position in the Residency for five months in spite of the disparity in numbers, but when the rebels in their turn were besieged their resistance was overcome in 19 days.

Lucknow to-day is a large and thriving city. Its population is close upon a quarter of a million, and Bombay, Calcutta, and Madras are the only cities in India that exceed it in size. I spent some time in the bazaars and was astonished to see the variety of trades and professions carried on there. Everything is done in the most primitive manner. There are no windows to the places of business and the dealers squat on the ground in their shops with their wares littered around them. The making of articles of silver and gun-metal, embroidery and painting on calico are perhaps the chief among the trades carried on in the bazaars.

To watch the men engaged in painting on calico is very interesting. Their designs are engraved on wooden blocks and they use the palm of the left hand as a colour palette. Having selected a number of blocks, they proceed to build up a design with them on the stretched out lawn or calico. They can only use one block at a time, and it is remarkable how clever they are in locating the correct place on the material without using any appliance whatever, simply relying on their skill and experience.

The next point in my journey was a place as famous as Lucknow, but for a different reason. This was Cawnpore, the well-known city on the southern bank of the Ganges that was the scene of inhuman massacres in 1857, when a handful of Englishmen defended weak entrenchments for a month and finally, after suffering incredible hardships, accepted the offer of a passage in boats down the river. The offer was made by the infamous Nana Sahib, who seized the opportunity to kill the defenceless men who had trusted him. Most of them were shot down or sabred as they embarked at the place now called Massacre Ghat. Few boats were pushed off from the bank, and only one broke through the ring of enemies, four survivors—two officers and two privates—escaping alive down the river.



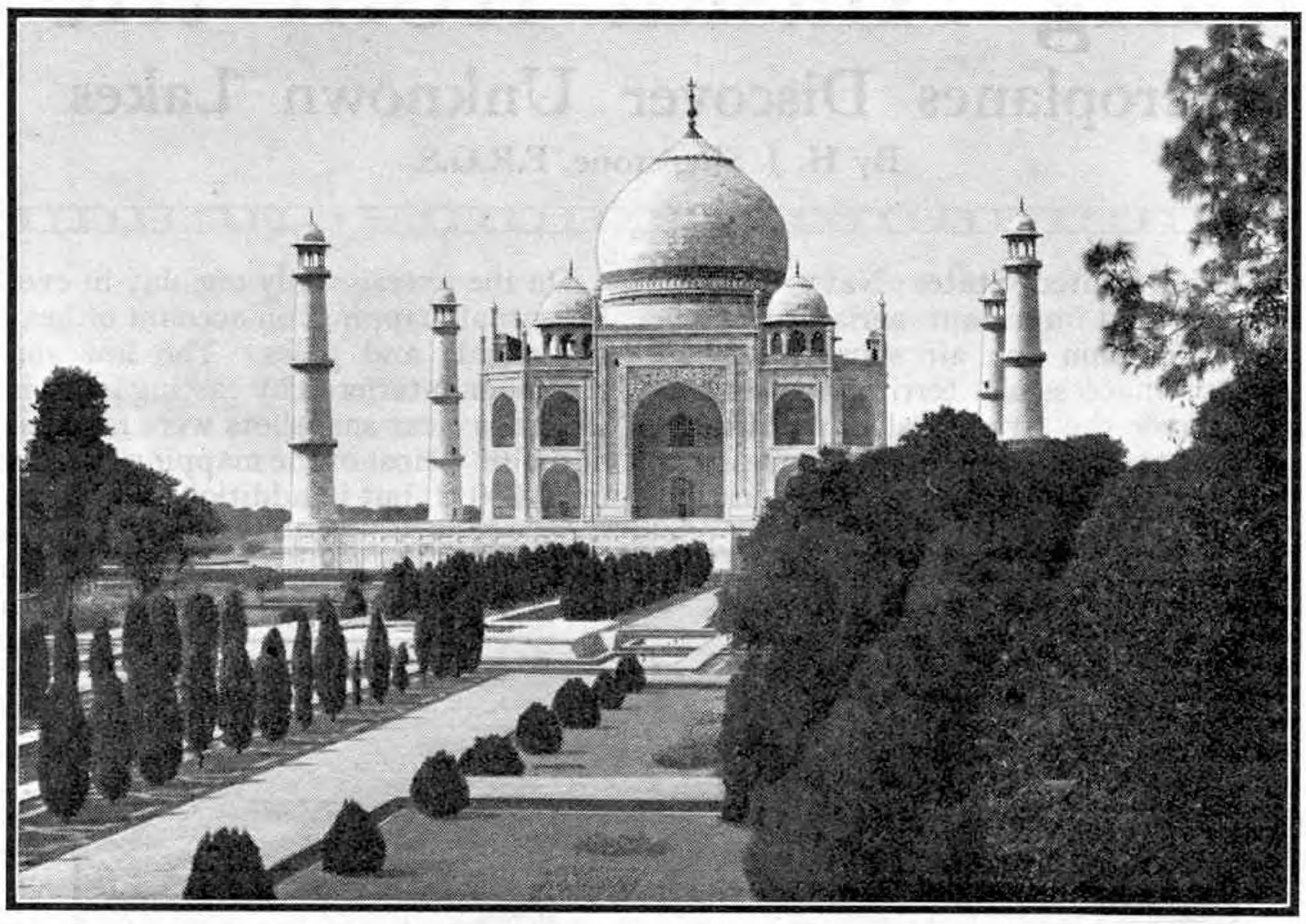
The Jasmine Tower in the Fort at Agra. Shahjahan, the builder of the Taj Mahal, died a prisoner here

The women and children to the number of 125 were imprisoned in a small house in Cawnpore, and when the relieving force approached were butchered along with fugitives from other places who had sought shelter in the fateful city.

Cawnpore is a dull town, best known to-day for the harness and leather work made there and distributed throughout India. The bazaar is of some interest and I secured a few photographs illustrating native life there and on the banks of the river, and after visiting the Massacre Ghat and other historic places I passed

on to visit the wonder city of Agra.

I arrived in Agra somewhat late at night, and after completing my arrangements at the hotel, I took a carriage drive to the world famous Taj Mahal, which was erected by the Emperor Shahjahan. It is mainly to this emperor and others of his dynasty that Agra owes its interest.

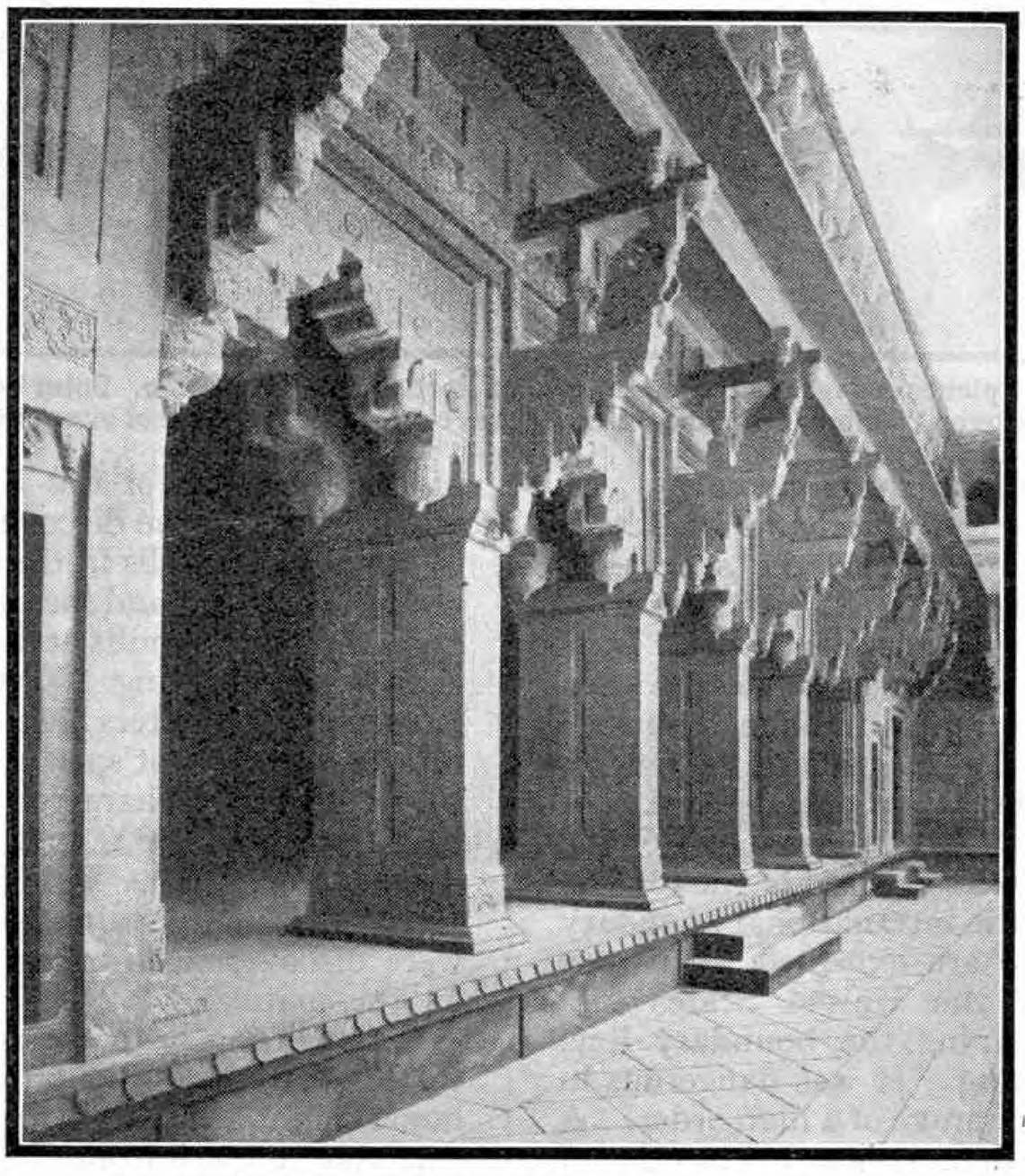


The Taj Mahal, the Mausoleum in which Shahjahan and his favourite wife Mumtaz Mahal are buried

One of the most remarkable features of the history of India is the regularity with which it has been invaded by Afghans, Persians and barbarians from Central Asia who have been attracted by its riches. The Moguls under the notorious Timour sacked most of the then prosperous cities in the plain of the Ganges a little more than 500 years ago and slaughtered thousands of their inhabitants. In 1525 Baber, a descendant of Timour, followed in the latter's footsteps, but carved out for himself a new empire instead of merely plundering the country. The dynasty that he founded only came to an end in 1857, the last of the line being banished to Rangoon by the British after the recapture of Delhi during the Indian Mutiny.

The greatest emperor of this line was Akbar the Great, grandson of Baber, who greatly extended the empire. He made Agra the capital in place of Delhi, and as the riches of India were at the disposal of the Mogul emperors the former city is now famous for the splendour and historic interest of its buildings.

Shahjahan was the grandson of Akbar and during his reign the Mogul Empire reached its greatest height. The Taj Mahal was erected by him as the mausoleum of his favourite wife, Mumtaz Mahal, and he also was buried there. It is a marble structure of impressive size and the tradition that 20,000 men laboured on it for 20 years is quite credible. The beauty of the many-domed building in its beautifully laid-out grounds completely obsessed me in a manner that no other structure ever did. I first saw it on a beautifully clear moonlight night, and I was so impressed that I made a further visit in the daytime, in order to examine the workmanship more closely.



Wonderful carved pillars in the palace erected in the Fort at Agra

The interior is panelled with beautifully carved marble, the carvings and tinted designs showing flowers only. In the central hall are marble lattice screens ornamented in a wonderful manner, and within these are the tombs. The tomb of the Empress is directly under the centre of the dome, and the larger one of Shahjahan stands to one side of it. As was the fashion in India under the Moguls, the walls and screens are inlaid with precious stones such as Jade, Lapis-Lazuli, Malachite and Cornelian, while on the tombstone of Mumtaz Mahal a magnificent diamond was originally fixed. This, however, has been removed at some time or other.

Another famous place of interest is the Fort. This is an enormous stone structure surrounded by a wall of battlements more than a mile in circumference. Around it is a huge moat across which are ponderous drawbridges. The gates are immense and imposing, and with the enormous bastions and towers give an appearance of solidity that must have been very comforting to the besieged and discouraging to the besiegers in times gone by. In 1857 it proved a safe refuge for the British, and yet 54 years earlier the Mahrattas surrendered it to Lord Lake after a siege of one day. Against modern guns, of course, it is indefensible.

Among the buildings there are two palaces, one of which is a red stone stronghold built by Shahjahan's father, while the other is a beautiful white marble building erected by Shahjahan himself. In addition there is a marble building known as the Pearl Mosque. This is a simple and beautifully proportioned structure of white marble that is in startling contrast to the sandstone platform on which it stands and the dull walls that surround it.

Shajahan died a prisoner in the fort which he had helped to beautify. His son rebelled and deposed him, thus following an example that he himself had set.

Agra is noted for the gold and silver embroidery that is woven there, the designs of which are most elaborate and the material very rich. This, like the embroidery at Lucknow, is done by men seated on the floor of the workroom with the material stretched on a frame.

After Agra I visited Delhi, a city that is equally associated with the Mogul dynasty. The Mogul Emperors changed their capital in bewildering fashion. Akbar the Great removed the Court from Delhi to Agra, his son Jahangir transferred it to Lahore, while Shahjahan brought it back again to Agra. The most curious effort in this direction was made by Akbar, who built a new capital Fatehpur—Sikri, 22 miles from Agra, only to abandon it a few years later. *(To be continued)*

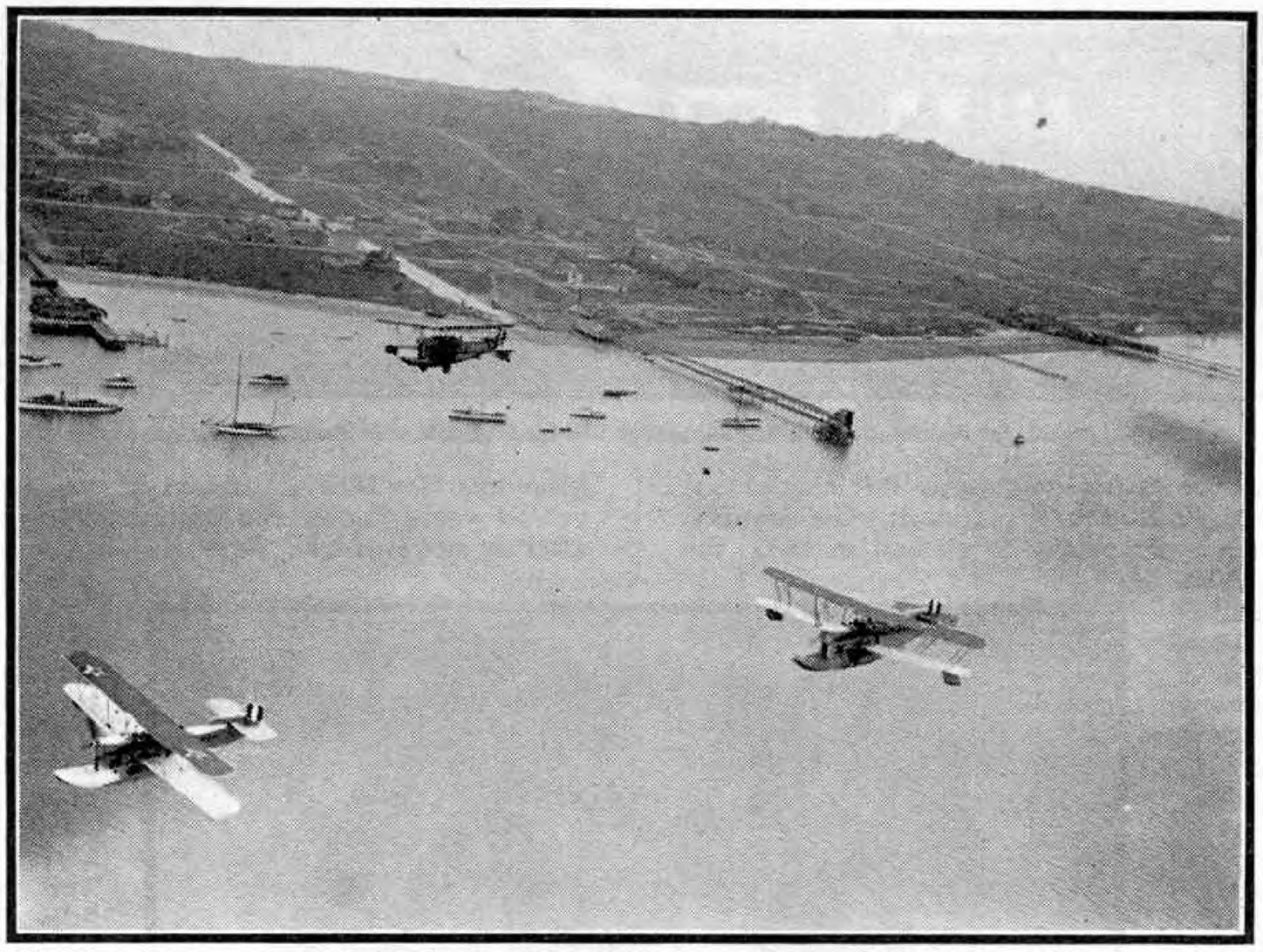
Mapping Alaska from the Air

Aeroplanes Discover Unknown Lakes

By H. J. Shepstone, F.R.G.S.

THE aeroplanes of the United States Navy have carried out a daring and important aerial survey in Alaska, mapping from the air some 40,000 square miles of almost inaccessible territory. Their mission was not to discover the strategical importance of this region from a military point of view, but to learn something of its industrial possibilities. The area concerned stretches for a distance of some 900 miles along the coast northward from the Indian village of Ketchikan, and is approximately 60 miles in width. It includes hundreds of islands, as well as parts of the mainland.

To have surveyed this territory in the ordinary manner would have occupied a period of several years and would have proved very arduous and costly. As it was, the whole region was accurately mapped in less than four months, and everything needful was learned concerning the possibilities of its immediate industrial development.



The three 'planes engaged in the survey, shown starting from San Diego. Point Loma is in the background. Before the 'planes returned they covered an aggregate of over 50,000 miles

The expedition was under the command of Lieut. B. H. Wyatt, a well-known airman in the service of the United States Navy. He used the all-metal Loening amphibian aeroplanes. An old mine-sweeper, the "*Gannet,*" acted as tender to the machines, while the men were accommodated in a substantial wooden "house" built upon a 250-ton freight lighter, 100 ft. in length, which was towed from point to point as needed.

Photographs were taken of all the islands, and of the mainland, and close-up views were secured of the forests, rivers and lakes. Pictures of the international boundary were also obtained, and these are expected to dispose of the controversy between the United States and Canadian Governments concerning the boundary line. The work proved highly exciting. It was dangerous in many respects and demanded courage of a high order. A crash or forced landing in the densely-wooded interior of the rugged islands or on the vast glacial ice fields of the mainland would have meant death to the aviators. Happily there were no accidents, and machines and men alike came through the trying ordeal with flying colours.

On the average only one day in every ten was suitable for actual mapping, on account of heavy rains, low-hanging clouds and gales. The low sun of morning and afternoon interfered by casting long shadows, but in open localities clear snapshots were made as late as 10 o'clock at night. Most of the mapping was done from an altitude of 10,000 ft. but in addition near views were taken of the forests to ascertain the type of timber, thickness of growth, and so on. In the same manner snaps were taken of lakes and rivers in order to discover the best way of harnessing them.

Many startling discoveries were made. The machines had not been long in the air before they discovered, behind Ketchikan, a lake nine miles in length and from four to five miles in width, the existence of which was unknown, even to the dwellers in the nearest settlements. It has been named "Grace," in compliment to Mrs. Coolidge, wife of the President of the United States.

As a result of the discovery of this and other lakes, and of certain waterfalls in the neighbourhood, arrangements are to be put in hand for the erection of an electric power station and pulp mills at Ketchikan. It is estimated that energy representing 100,000 h.p. can be obtained by harnessing the waters here, while all around them are vast forests of the finest spruce, pine and hemlock. Mr. C. H. Flory, who is in charge of the forests of Alaska, declares that from 500 to 600 tons of paper could be turned out daily from mills at Ketchikan for an almost indefinite period. Equally valuable timber and power resources were discovered on other islands, as well as at points on the mainland.

Commenting on these aerial surveys Mr. Flory says: "I learned more about the forests of Alaska in a two-hours' flight I made in one of the aeroplanes than I ever was able to learn from my own years of observation and the records of those who preceded me. The Government departments in Alaska will be saved many thousands of pounds by these operations. Projects that ordinarily require a year for my department to survey were accomplished in an hour by the aeroplanes, while in the same

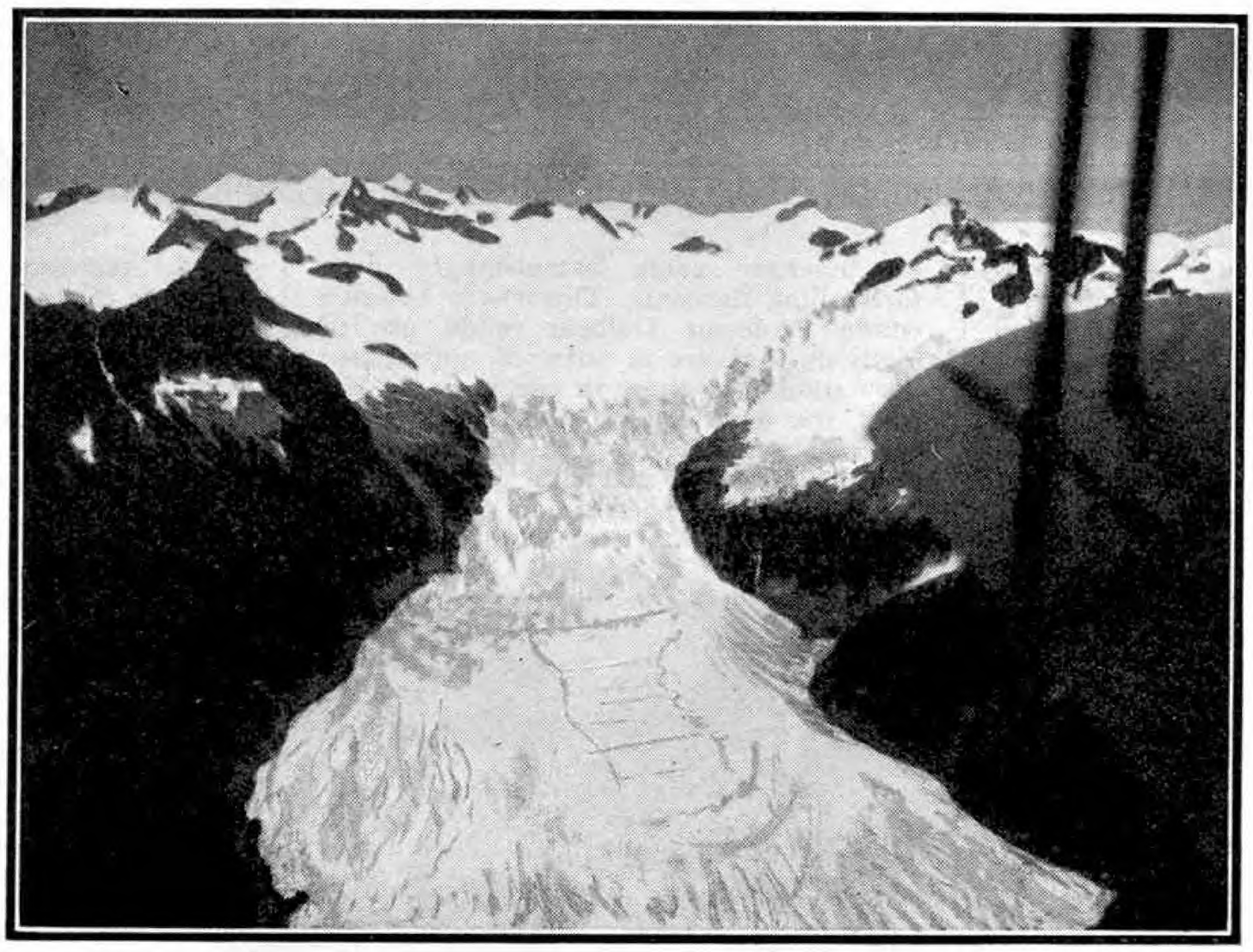
flights they achieved other objects as well. So accurate are the pictures that every tree in the timber areas can be counted, timber suitable for mill use and for pulp can be segregated, and much of the work we are now doing at considerable cost eliminated."

Another point of great value noted was this. So close generally is the stand of the trees that the sun cannot reach the soil, and rains keep it constantly wet. As a result reforestation would be a quick and perpetual process.

Of the three aeroplanes, two were employed for mapping and the third was used as a standby, ready at all times to go to the rescue in case of call, or to search should one of the other machines fail to return when due. Emergency rations and carrier pigeons were taken on every mapping flight, and each machine carried a pilot, a navigator and a photographer. The work was highly technical and exacting, and every man was busy every moment in the air.

Flying was rendered very difficult by sudden winds, locally termed "willie waws," that blow down from the mountain tops with a velocity ranging from 50 to as much as 100 miles an hour. They usually spring up on clear days, and it is impossible to forecast them. One of the machines encountered a "willie waw" while taking oblique photographs at a comparatively low elevation over Le Conte Glacier. It was forced down to within a few feet of the ice, and being unable to rise had to skim along the top of the glacier for a distance of 15 miles and then for five miles across the bay, only escaping the countless small icebergs by a hair's breadth. The speed meter indicated 115 miles an hour, yet for 20 miles the wind bore the aeroplane perilously low.

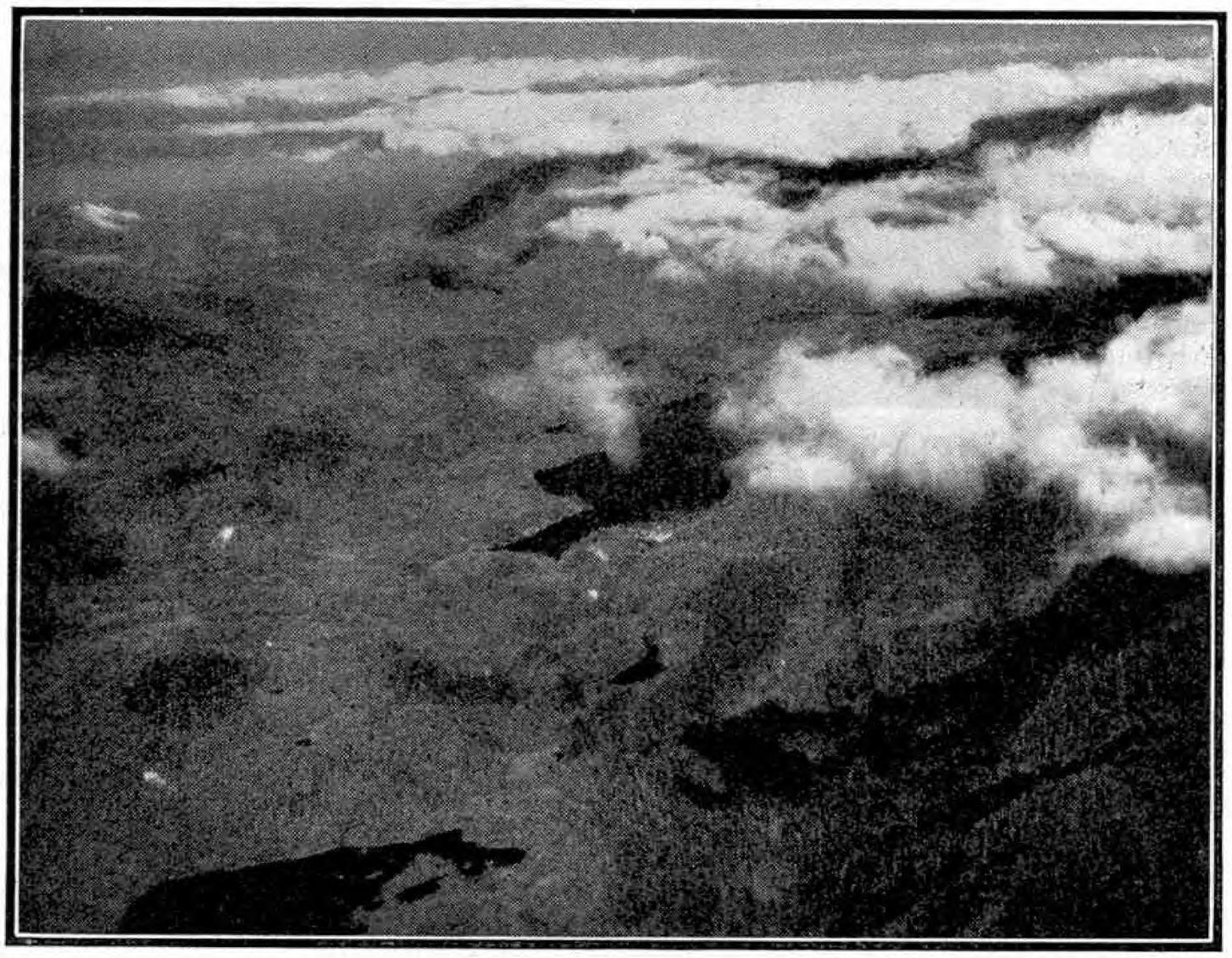
The highest climb made was that of Lieut. Wyatt, the officer in charge, who went up to 14,400 ft. to obtain close-up photographs of the lofty Fairweather group along the international boundary, 125 miles north-west of Juneau. Mt. Fairweather is 15,480 ft. in height and the adjacent ranges vary from 8,000 to 14,000 ft. The approach had to be from the south-west and a 60-mile wind was driving from the north-west, resulting in violent down-bumps. Although the machine had been lightened as much as possible it could not be forced up higher than 14,400 ft. Then it struck a strong down current and dropped to less than 200 ft. above the snow-covered jagged edges of the mountains. It was a narrow escape, and in the jolts that occurred the camera was thrown against the side of the cockpit and smashed.



The head of Baird Glacier showing that such a body of ice is formed in a similar manner to a river

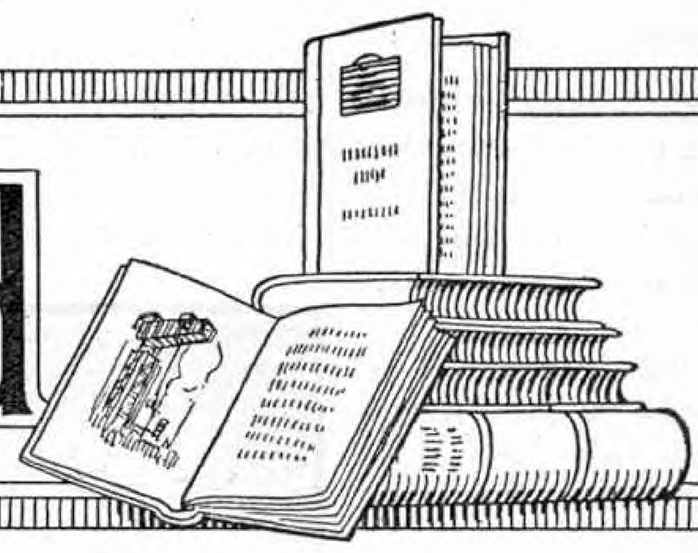
Much magnificent scenery was observed, including snow-capped peaks, mountain lakes, waterfalls and glaciers. From on high some of the bays, particularly those served by glacial streams, had a charm all their own. They were dotted with bergs and floating ice which to the airmen had the appearance of water lilies or stars in an inverted sky, the whole being framed by a black-green forest of brilliant luxuriance. Although the Alaskan coast is pitted with glaciers and its waters are strewn with floating ice, the temperature is certainly not Arctic, and in late September the gardens of Juneau and Skagway were full of bloom. The ship's cold-storage plant was supplied

(*Continued on page 225*)



The Fish Hatchery (white spot near centre of photograph) at Fortmann, on Revillagagigedo Island, from 5,000 ft. up

Books to Read



Readers frequently write asking if we can recommend books that are both of interest and of use. On these pages we review books that will specially appeal to readers of the "M.M." We do not actually supply these books, which may be obtained either through any bookseller or direct from the publishers.—EDITOR.

"Pioneers of Wireless"

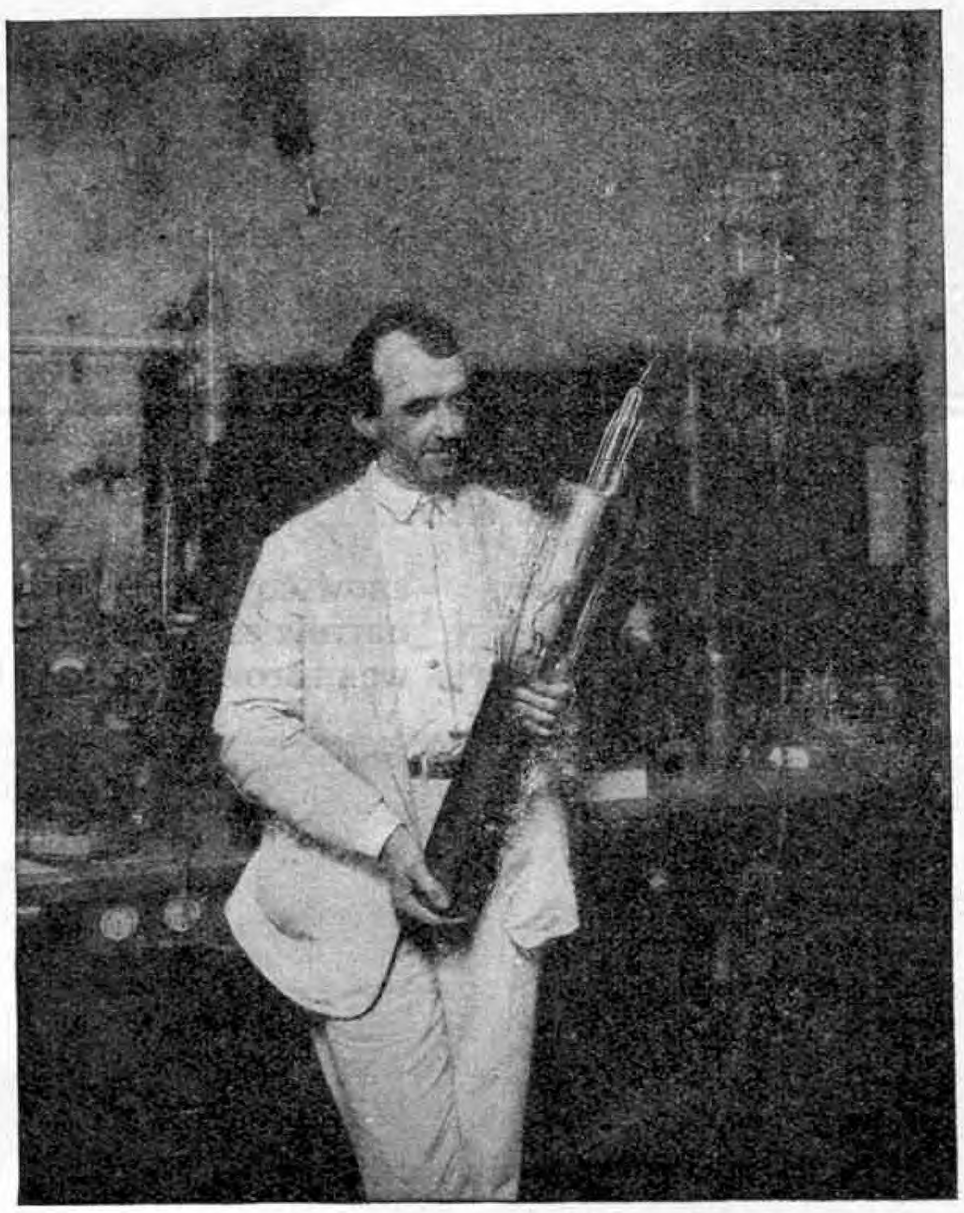
By Ellison Hawks, F.R.A.S.
(Methuen & Co. Ltd. 12/6 net)

The purpose of this book is to give a carefully balanced account of the development of the science of wireless from its beginning. A list of notable pioneers and a brief chronology at the beginning of the book arouses hopes in the mind of the reader that the history of wireless is to be dealt with fully and adequately in the succeeding pages. This hope is certainly fulfilled, and not the least merit of the book is that it makes clear the fact that communication without wires is not the outcome of the work of one or two men but is, to quote the author, "the result of the labours of a large number of pioneers, whose researches, made with a definite object in view, extend over the past century."

The story begins with William Gilbert's discoveries in magnetism in the reign of Queen Elizabeth and continues through the following 200 years with the discovery of contact electricity and the voltaic battery, and with the foundation of the science of electro-magnetism. The remarkable career of Faraday, the founder of electrical science, is next described with future applications of his work particularly in view.

Gilbert, Galvani, Volta, Faraday and others, including Sturgeon and Henry, the discoverers of the electro-magnet, are quite properly classed here as "Pioneers of Wireless," as it is on the basis of their work that all subsequent progress was made, while the accounts of their achievements assist greatly in making the story comprehensive to those whose knowledge of electricity is not deep. The author's lucid account of Faraday's discoveries, for example, shows how they led directly to the epoch-making work of the brilliant Scottish scientist, Clerk Maxwell, who first realised the probability of the existence of wireless waves. The same argument justifies the appearance in these pages of Steinheil, who first used the earth in place of a return wire, and of Graham Bell, the inventor of the telephone.

The later chapters describe the work of those who actually attempted signalling without wires long before Marconi's time, and it is astonishing to learn how much was really done. Most of the inventors of the earlier period made use of induction methods, or signalled across rivers making use of water as a conductor instead of wires. In at least one case an inventor came astonishingly near forestalling Marconi. This was in America where Professor Dolbear made use of methods that are in outward appearance very similar to those in use to-day. His work was done prior to the prediction by Clerk Maxwell, and the discovery by Hertz, of electro-magnetic waves. Had these discoveries been known to him there is little doubt that he would have been successful in signalling without wires by the methods now in use.



"Some Valve!"—Dr. Housekeeper and one of his 1,000 k.w. Valves (From "Pioneers of Wireless," by Ellison Hawks, reviewed on this page)

The story of the fundamental discovery of wireless waves and its later development into systems of wireless communication is fairly and completely told, and it will be pleasing to British readers to note the great part played by Lodge and Fleming. The former was the first to realise the importance of tuning, while Fleming was the inventor of the now well-known valve, a scientific production that revolutionised the methods of reception. The control grid that made the valve of use as an amplifier was introduced later by the American, Lee de Forest.

The history of wireless is not dull by any means and Mr. Ellison Hawks—as would be expected from the editor of such a bright publication as the "*M.M.*"—has succeeded in rendering it more attractive by presenting it as the story of the pioneers themselves, and by the use of many excellently chosen illustrations. It may not, perhaps, add to our knowledge of wireless to read how Arago was twice imprisoned as a spy in Spain and was shipwrecked on the Algerian coast, or how Sturgeon's earlier work was carried on in barracks while he was serving his time as a gunner in the Royal Artillery, but it does add interest to the story to learn these things. What is more important and indeed essential—it enables us to realise the character of the men to whose study and persistent striving we owe the wonderful methods by which we may communicate with any part of the earth more easily than our ancestors of 200 years ago could communicate with the next village. Thus a very readable and informative book has been produced, and one that fills a gap in the literature of the subject, for it is the first attempt to write a History of Wireless.

F.R.

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A Book for "Bullets" Competitors

(Frederick Warne & Co. Ltd. 2/- net)

It is a curious sign of the times to come across a book entitled "*The Way to Win*," written for the express purpose of assisting those who enter for "Bullets," "Nuggets," and other similar competitions. The author attempts to convince us that this type of newspaper contest provides an ideal home pastime at an extremely small cost, and he would even persuade us that the regular competitor will become a good conversationalist and a great critic.

This may or may not be the case, but at any rate the book does give an astonishing amount of sound advice that undoubtedly will assist those who indulge in this pastime and may possibly result in their acquiring one of the much coveted cheques! The author obviously has gone into the matter very deeply and he has produced a really practical handbook dealing with the subject from all angles.

* * * *

"The Fascination of our Railways"

By "Mercury"

(John Bale, Sons & Danielsson Ltd., London)

This recent addition to the many popular books on railways imparts an immense amount of information in an interesting manner. The descriptions of the various mechanisms are technically accurate and yet easy to follow, the sections dealing with signalling being remarkably comprehensive considering the space available.

The illustrations are not only numerous but excellently reproduced and they

obviously have been selected with great care to supplement the written descriptions. This is a book that can be recommended to railway enthusiasts of all ages.

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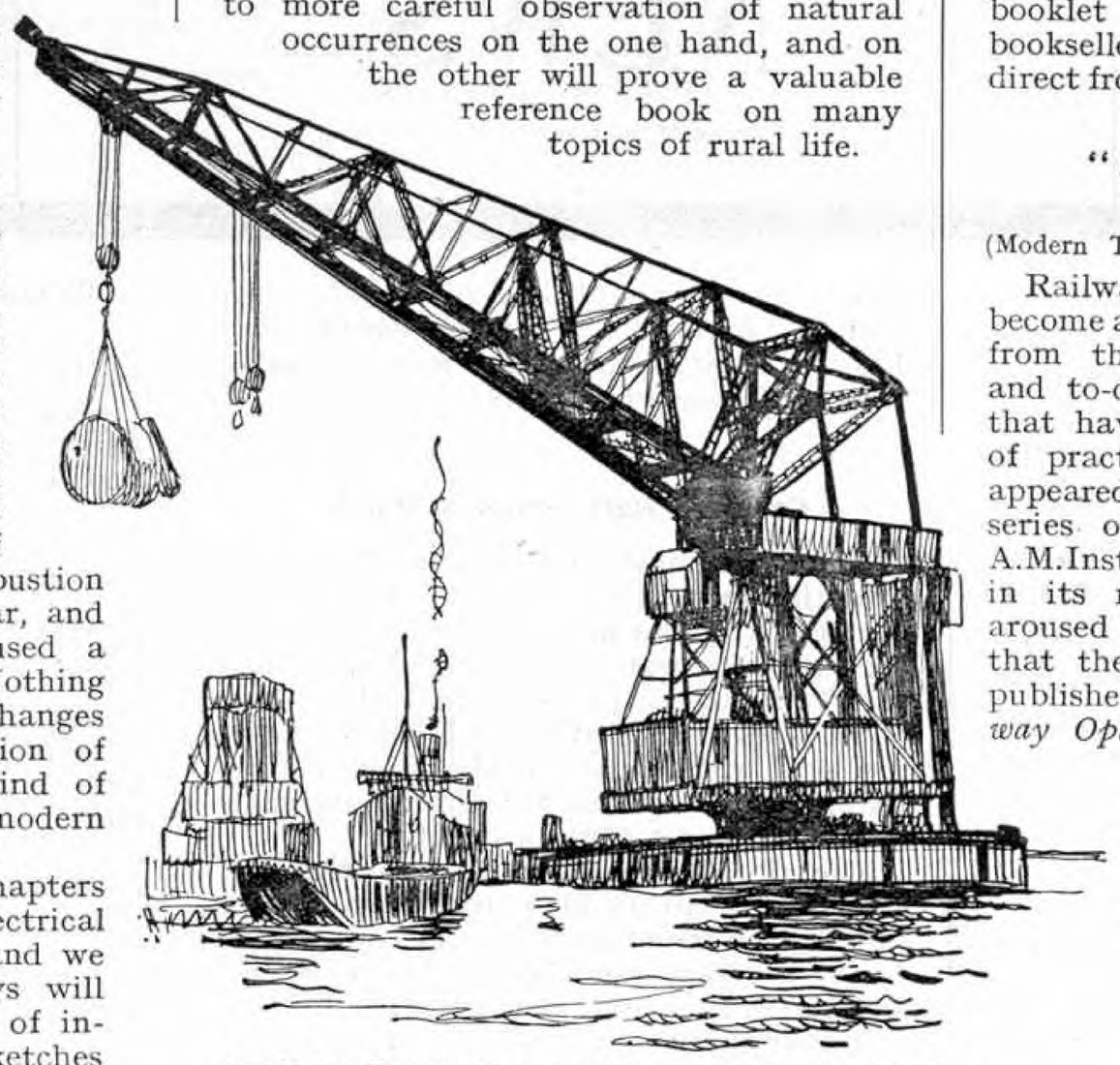
"The World of Machines"

By PERCY M. BAKER, M.B.E., B.Sc., etc.
(Wells Gardner. 7/6)

Many books have been written on the engineering wonders that surround us to-day, but the addition of the present work is by no means unwelcome.

Mr. Baker rendered distinguished service in the Ministry of Munitions during the great war and in this volume he gives a full and clear description and up-to-date information about the extraordinary world of machines in which we are living. He deals with such interesting subjects as the production of high-speed or high-tensile steel, which has revolutionised every process of manufacture; the internal combustion engine which made the motor car, and the water-tube boiler that caused a revolution in engineering. Nothing so remarkable as these recent changes has happened since the invention of printing, which changed the mind of mankind as drastically as modern engineering is changing it now.

The book also contains chapters on water power, hydraulics and electrical engineering, ships and bridges, and we feel sure that all Meccano boys will find the book a veritable mine of information. There are over 200 sketches and diagrams and it is pleasing to notice that all of these are very clear and easily understandable.



A 200-ton Floating Crane lifting a boiler on board a ship
(From "The World of Machines," reviewed on this page)

* * * *

"The Lure of the Countryside"

By W. COLES-FINCH (Daniel Company, London. 21/-)

Mr. Coles-Finch is well known to many readers of the "*M.M.*," to whom his articles on pond life and aquariums have been exceptionally helpful. He is also the author of interesting books on Water—a surprisingly fascinating subject in his hands—and on scenes of rural life, which have established his reputation as one who is able to express himself in the homeliest language without becoming dull.

The book at present under review is more ambitious in scale than his previous works, for it deals with the life of the countryside in practically all its phases. The author is a scientist and an engineer. His trained eye misses nothing, and the combination of accuracy and sympathetic appreciation of the wonders of Nature have resulted in the production of a fascinating book. It is a volume that will serve admirably as a guide to old and young alike on country tramps and explorations, and will at the same time provide excellent and instructive entertainment by the fireside.

Windmills and watermills; seed-time and harvest; the miracles of frost and snow; and Nature's winter preparations for the coming summer are among the subjects dealt with in a delightfully conversational manner. The charm of the book is increased by the astonishing number of excellent illustrations, most of which are from the author's own photographs, and by the coloured frontispiece entitled "Bluebell Time" contributed by Mr. Donald Maxwell.

Even readers not consciously attracted by country life will find much of interest in the book, while the copious information, easy style and wealth of anecdote cannot fail to make it attractive to Nature lovers of all ages. Boys in particular will find it a useful guide, and a study of it will clothe in a most fascinating manner the dry bones of natural science as learned from more stereotyped books. It will impel the reader to more careful observation of natural occurrences on the one hand, and on the other will prove a valuable reference book on many topics of rural life.

"The *Radio Year Book*"

(Sir Isaac Pitman & Sons Ltd. 1/6 net)

This is the sixth annual appearance of the "*Radio Year Book*" and the standard of previous issues is more than maintained. As usual, it contains a review of the past year's progress in all departments of wireless, and the section dealing with the B.B.C. is particularly interesting in view of the change of control that came into effect last year. Professor Fleming, Captain Eckersley and others contribute articles on various topics. Of these, two call for special notice—one dealing with the crystal set and how to obtain the best results from it, and the other discussing the possibility that there is no such thing as the ether. The latter article will serve a good purpose if it reminds us that the ether is really an invention made by scientists to account for certain phenomena in electricity and light. The book is well illustrated and includes a fine pictorial record of the outstanding achievements of the year in broadcasting.

* * * *

Booklet of the "*Lord Nelson*"

(Locomotive Publishing Co. 1/6)

An interesting booklet dealing with the Southern Railway locomotive "*Lord Nelson*" has been issued by the Locomotive Publishing Co. Ltd., 3, Amen Corner, E.C.4. The main feature of the booklet is the two large folding plates, one of which is in colours and represents a side elevation of the locomotive, while the other is a plan in black and white. In addition there are two other plates showing the elevation of the cab and smoke box ends and also sections of the cylinders and firebox. All these drawings are fully numbered to correspond with an index of no less than 260 named parts, so that reference to any detail is perfectly easy. A full-page reproduction of a photograph gives an excellent idea of the handsome appearance of the "*Lord Nelson*" and an introduction gives a description of the engine, together with its leading particulars. This interesting booklet may be ordered through any bookseller for 1/6 or may be obtained direct from the publishers at the same price.

* * * *

"British Railway Operation"

By T. BERNARD HARE
(Modern Transport Publishing Co. Ltd. 3/6 net)

Railway operation may not yet have become a science, but at least it has emerged from the stage of haphazard methods and to-day is based on sound principles that have been formulated as the result of practical experience. There recently appeared in "*Modern Transport*" a series of articles by Mr. T. B. Hare, A.M.Inst.T., dealing fully with this subject in its many aspects, and the interest aroused by these articles was so great that they have now been collected and published under the title "*British Railway Operation.*"

As a hand book for the railway student it would be hard to imagine anything better, but the book goes beyond this, for it is written in such a clear, concise and interesting style that it will appeal to all who take an interest in the working of British railways. The chapters dealing with passenger and goods stations and marshalling yards are of particular value on account of the clearness with which the underlying principles are explained, and the section devoted to passenger services should go far towards explaining to the uninitiated why certain public demands cannot be met on account of their economic unsoundness. Passing on to deal with electrification generally, and the Underground Railways in particular, the book concludes with an interesting account of the development of railway organisation up to its present high state of efficiency.

Interesting New Books

We hope to deal with the undermentioned books in an early issue.

"SEA SONGS AND SHANTIES"
collected by Capt. W. B. Whall (Brown, Son & Ferguson), 5/-

"FREDA AT SCHOOL"
by Margaret C. Field (Fredk. Warne), 1/-

"BUNCH AT BOARDING SCHOOL"
by Ethel M. Talbot (Fredk. Warne), 1/-

"GREEN SHOES"
by Dories Twinn (Fredk. Warne), 1/-

"CUBS TO THE RESCUE"
by R. S. Lyons (Fredk. Warne), 1/-

"NONSENSE BOTANY AND ALPHABETS"
by Edward Lear (Fredk. Warne), 6/-

"QUEST OF YOUTH"
by Jeffery Farnol (Sampson Low), 7/6

"THE DISCOVERY OF AMERICA BY JOHN CABOT AND HIS SON, SEBASTIAN"
by Charles Challenger (Stockwell), 2/6

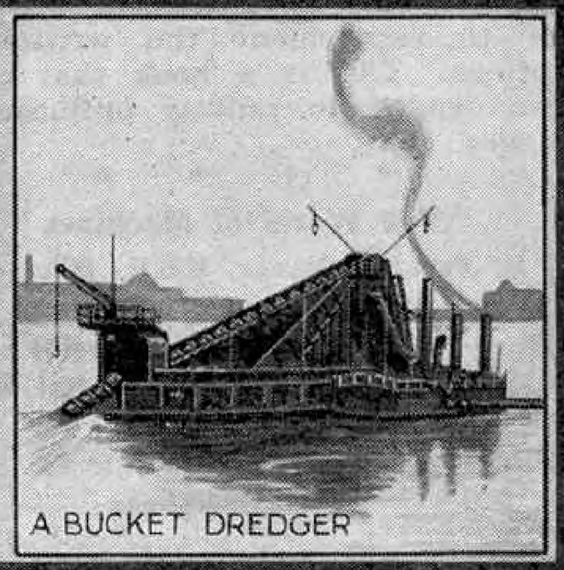
"HIKE AND TREK"
by G. F. Morton (Harrap), 3/6

"TOURING ENGLAND BY ROAD AND BY-WAY" *by* Sydney R. Jones (Batsford), 7/6

"NOTES FROM MY SOUTH SEA LOG"
by Louis Becke (Werner Laurie), 5/-


A GRAB DREDGER

ENGINEERING NEWS


A BUCKET DREDGER

New Motors for London Trams

More than 50 Metropolitan Tramway cars recently have been equipped with a new type of light-weight high-speed motor. As a result the running time of cars in the North-west district of London has been reduced by as much as 15 per cent., not by increasing the actual speed of the car, but by improvement in accelerating power and braking. It is claimed that the new motor enables these cars to achieve the highest average speed of all electric road-track vehicles in Europe, for the official maximum speed of 20 m.p.h. can be attained in 15 seconds. The improvement in braking has been achieved by the use of magnetic brakes.

* * * *

The Automatic Telephone in Australia

Work will shortly be commenced on the conversion of the whole of the Australian Postal Authority's city telephone services from manual to automatic operation. The cost of the conversion is estimated at £3,000,000, and the programme under which it is to be carried out covers five years and involves the creation of 53 new automatic exchanges serving 111,782 subscribers. Most of these will be conversions of existing manual exchanges, but several will be entirely new. Additions to existing trunk line services also are contemplated. The major proportion of these are supplementary to existing lines between the capital cities, but there will also be extensions to many parts of the country at present indirectly served.

* * * *

Electricity from Peat

Ireland's greatest natural fuel is peat and research work is being conducted with a view to the establishment of an experimental station burning peat for the generation of electricity. The part that peat plays in Irish national life is shown by the fact that no less than 6,000,000 tons of air-dried peat are burned each year as fuel, this being the equivalent of 3,000,000 tons of ordinary coal, the amount that is annually imported into the Free State.

* * * *

Improving a Mersey Dock

The channel entrance to the Alfred Dock on the Birkenhead side of the River Mersey is at present being deepened and widened. As the scheme involves the removal of a wall dividing the entrance into two locks, in order to make one large lock, it was necessary to remove the 250-ton iron swing bridge across the dock to make way for a new structure 670 tons in weight with a clear span of 80 ft. The removal of the bridge, which had to be cut into three pieces, was accomplished by the floating crane "*Mammoth*," which swung the 120-ton sections out of the way just as if they were bags of feathers.

* * * *

Concrete Raft across a Marsh

One of the most interesting road-making jobs that have been carried out recently is a stretch half-a-mile in length traversing the extensive peat bogs between Carrbridge and Tomatin, Inverness-shire. This piece of road lies at an altitude of 1,200 ft. above sea level and is part of the main Perth-Inverness road across the Grampians that is now in course of reconstruction.

The problem that confronted the engineers was to build a road capable of taking the comparatively heavy traffic across the very unstable marshy sub-soil, and the difficulty was accentuated by the fact that there was no means of diverting the traffic while the job was in hand. It was finally decided to lay a strongly reinforced concrete raft, 21 ft. in width and 8 in. in thickness. Each individual slab of concrete in the raft has been constructed in the form of an inverted trough, with sides 10 in. in depth and 6 in. in width. The object of this form of construction is to prevent the soft peat immediately below from being squeezed out as heavy traffic passes overhead.

* * * *

The New Mersey Tunnel

Exceptionally good progress is being made with the new traffic tunnel under the River Mersey, and out of a total length of 17,600 ft. of headings to be driven, all but 4,000 had been completed by the middle of January. The work is being carried on from both sides of the river and it is anticipated that the headings will meet under the river toward the middle of April. Boring is being carried on continuously night and day, except at week-ends.

* * * *

Long Distance Cables

The Manitoba Government have now taken over the supervision of the distribution of electric power throughout the State. During 1927 the supply was extended to 16 new towns and villages, and branch lines from the main cables were carried to several farms lying between towns. The power used on the Government system is drawn from the Winnipeg plant, which is located some 70 miles east of that city, and this plant is now supplying places more than 250 miles away from its headquarters.

Canadian Water Power Development

An interesting summary of hydro-electric and water-power development in Canada during the past year has been issued by the Dominion Water Power and Reclamation Service of the Department of the Interior. This shows that the intense activity of recent years has been well maintained and that the schemes in hand predict no abatement in 1928 and the years following. New installations total 221,655 h.p., while other new works are so far advanced that before the end of next July a further total of 378,000 h.p. will be ready for service. With the inclusion of this latter figure Canada will possess hydro-electric stations developing 5,100,000 h.p. This figure is more than twice the total at the end of 1920 and affords a clear illustration of the remarkable progress that has been made.

In addition to the projects already referred to, it is probable that this year constructional work will begin on the largest hydro-electric power development yet undertaken in any country. The plant will be located on the St. Lawrence river, just west of the island of Montreal, and its position not more than 25 miles from the centre of the city ensures that the supply of power will meet with an eager demand. In fact, it is said that the initial output of 300,000 h.p. has already been sold to companies interested in electro-chemical, electro-metallurgical and other industries that will erect plants in Canada as soon as power is available.

The ultimate capacity of the plant to be erected is more than 2,000,000 h.p. This will be obtained by taking advantage of the head of water between Lake St. Francis and Lake St. Louis. A canal will be cut between the two lakes, and at the lower end of this a power house will be erected to take advantage of the fall of 83 ft. that takes place in the 13 miles of its length. Incidentally, the canal will also be available for navigational purposes, and profitable developments in this direction are confidently expected.

* * * *

Enlarging the Panama Canal

Traffic through the Panama Canal last year reached 26,227,815 tons, the largest total ever dealt with in one year and an increase of over 1,400,000 tons as compared with the previous year. British ships comprised approximately 25 per cent. of the total and American tonnage 55 per cent.

It is intended to carry out deepening of the Gaillard Cut in the dry seasons with a view to speeding up traffic and reducing the risk of accidents.

How The Admiralty Solved a Road Problem

One would hardly connect the passing of the sailing ship and the birth of the steamship with a road-making problem, but actually an interesting link exists. Some 60 years ago the Admiralty officials responsible for dockyard maintenance found that the roads inside the dockyards were cutting up very badly on account of the increased weight of the traffic passing along to the berths, due to the introduction of the heavy engines and heavier armour plate used in the power-driven vessels. With the traditional adaptability of the Navy, the very ships whose passing had created the problem of the provision of stronger roads were made to supply the solution.

The old sailing ships had carried pig iron as ballast, and when they became obsolete this ballast was unloaded and stacked in the dockyards. It was not required for the new steam-driven ships, and before many years had passed the accumulation of "pigs" proved an embarrassment. Some were 3 ft. in length and 6 in. square, others were 18 in. in length, 6 in. in breadth and 4½ in. in depth. Five cubic feet of the material weighed a ton, and according to "*The Engineer*" there were 40,000 tons in stock!

The Admiralty tried hard to sell the iron, but in six years only 1,800 tons were disposed of. It was then that someone had a "brainwave," and the Admiralty used up the whole lot for road-making!

* * *

Brazil's Hydro-Electric Capacity

The Brazilian Government have just completed a rough survey of the country's water power resources. Over 11,000 waterfalls suitable for use in hydro-electric schemes have been scheduled and these have an estimated total capacity of 2,500,000 h.p. In almost every case the construction of storage dams presents no difficulty, for the streams maintain a fairly constant flow, due to a uniform rainfall.

* * * *

Municipal Heating Installations

A remarkable scheme of public heating has been inaugurated by the Paris Municipal Authorities. In connection with this all the buildings in certain districts are to be heated from a central station, the supply being laid on in a similar manner to that for water and lighting. A private contractor is carrying out the work and has undertaken to supply heat to 7,000 flats in the Opera quarter within the next five years. This involves the laying of over 3¾ miles of mains at an approximate cost of £400,000.

The pipes are to be laid in tunnels, and it is understood that as opportunity offers the remaining municipal supply pipes for gas, electricity and water will be moved into the same tunnels. This latter proposal is eminently practical for the successive uprooting of roads for attention to one or other of the pipes below the surface has become a serious nuisance.

* * * *

The Passing of H.M.S. "*Glasgow*"

H.M.S. "*Glasgow*," the only British cruiser to take part in both the battles of Coronel and the Falkland Islands in the Great War, has been dismantled at Morecambe.

* * * *

In order to replace a 50-year-old valve in their Walker Wood reservoir near Stalybridge, the Ashton, Stalybridge, and Dukinfield Waterworks Committee recently found it necessary to drain off the reservoir, which is 61 ft. in depth and has a capacity of over 200,000,000 gallons. This task was accomplished by running off 5,000,000 gallons a day into the River Tame.

Famous Bridges from the Air—No. 1



Photo] [*Aerofilms Ltd.*

A striking aerial view of the Tower Bridge, with the Tower of London in the right foreground.

The photograph conveys a remarkable impression of the density of building in the City. The aeroplane overhead is a Dutch air-liner.

Proposed New Tees Bridge

At a recent meeting of the Middlesbrough Corporation the proposal to build a new bridge across the Tees at Newport came up for discussion. Two schemes were considered, the first for a bridge with a span of 300 ft. and the second for a span of 350 ft. It was decided to put forward the former for the consideration of the Tees Conservancy Commissioners, who are the final arbiters in the matter. It was stated during the meeting that a suggestion for a tunnel under the river instead of a bridge had been rejected by the Commissioners.

* * *

Great Change-over of Labour

Some recent statistics issued by the Federation of British Industries show that during the last four years there has been a remarkable change-over of occupation among the labouring classes. Actually some 875,000 workmen have thrown up their original means of livelihood and taken up occupation in one or another of 34 new trades.

The explanation is that during the four years certain industries have expanded very rapidly, and for their labour requirements they have drawn upon industries that have been seriously depressed and unable to offer their workers a reasonable rate of pay. For example, the electrical engineering and motor engineering trades have increased the labour complements by 59,000 men. The artificial silk industry has created openings for 17,000 and the hosiery trade for 11,000. New road-making and other public improvements have created work for 173,000 men and road transport for 49,000, while house-building and furnishing have absorbed 55,000 new employees. Against these figures the shipbuilding industries employed 125,000 fewer people than in 1921. The most remarkable figures of all are shown in the distributive trades, which have increased their staffs by 327,000. It is estimated that over 200,000 workers have permanently left the depressed industries and linked themselves up with those that are prospering.

* * * *

Messrs. Swan, Hunter & Wigham-Richardson are engaged on building a train-carrying vessel that is to inaugurate a new train ferry service between New Orleans in the United States and Havana in Cuba. The ship will have a dead-weight of 8,000 tons and will be 420 ft. in length. The engines will be of the ordinary steam turbine type.

Famous Trains—(*continued from page 217*)

carries the breathless traveller up no less than 2,145 ft. with a maximum gradient of 87.8 per cent., which is rather steeper than 1 in 1¼! It claims, and not without reason, to be the steepest railway in the world, and, like most lines of a steeper inclination than 1 in 2, is worked by a steel cable.

Below Piotta, on our journey, comes some even more striking engineering than that of Gurtnellen and Wassen. From Rodi Fiesso to Faido, as the crow flies, is only 2½ miles, but the difference in level between the two places is 613 ft., and in order to overcome it the railway has circuitously to travel five miles, with a maximum gradient of 1 in 38, threading on the way two tunnels that are completely spiral. Then, as the river rushes down the Biaschina Ravine, and we approach Giornico, just before we enter Piano Tondo Tunnel, we notice a second stretch of the line below us, and a further stretch below that, the latter making its exit from the mountain-side some 300 ft. below our entrance. Here there are two corkscrew tunnels—Piano Tondo and Travi, both just under a mile in length—side by side, in order that the railway may keep pace with the sudden fall in the level of the valley-floor. A downward run of 41 miles from Airolo brings us to Bellinzona, where we have fallen to a level of 760 ft., or just over 3,000 below the level of the St. Gotthard Tunnel. The time is now 11.35 a.m. and the stop lasts but two minutes.

Bellinzona is the junction for the historic town of Locarno, which we see, some miles off, on the shores of Lake Maggiore, as we ascend to the mile-long Monte Ceceri Tunnel that carries us under the watershed separating the Ticino Valley from that of the Lake of Lugano. This has necessitated a fresh ascent of 800 ft. in 8¾ miles, once again on single line, to Rivera (1,560 ft.), after which we drop a corresponding distance, down the fertile Vedeggio Valley, to lovely Lugano, where the station is high above the lake and 1,010 ft. above the sea. The time of the halt here is from 12.7 to 12.10 midday.

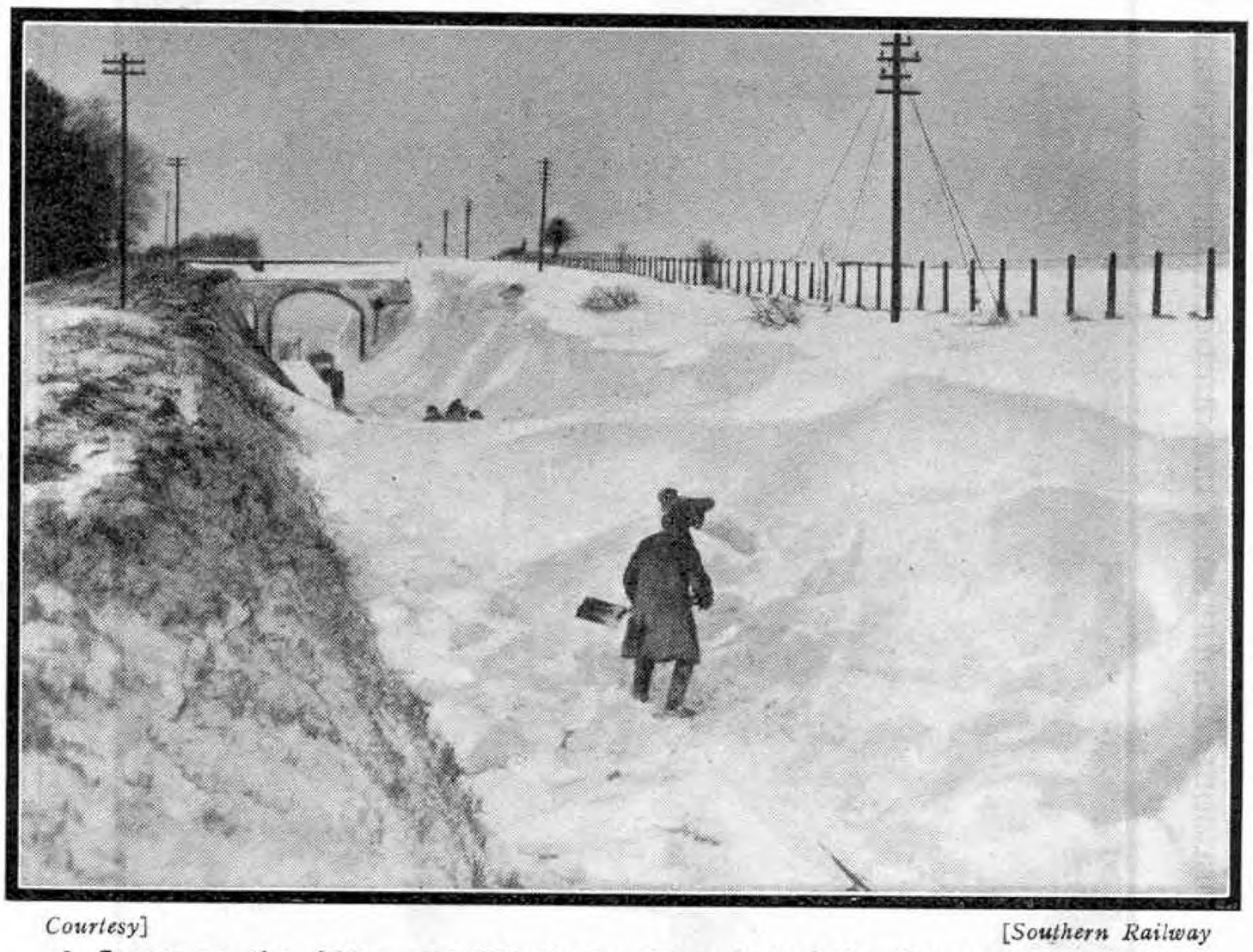
Skirting the shore of the lake, by means of tunnels and bold viaducts, we descend to the lakeside at Melide, and then cut clean across the lake by a remarkable causeway to Bissone. Here we are down to 900 ft., but another rise of 280 ft. ensues in the next six miles, ere we can drop to the frontier station at Chiasso, reached at 12.34 p.m.

Within Swiss territory the "*St. Gotthard Pullman*" has now travelled for 198 miles, of which 140 miles have been over the marvellous St. Gotthard route. In the course of this latter distance it has passed through 80 tunnels whose aggregate length is 28½ miles, and over no less than 324 bridges of more than 32 ft. span, many of them viaducts of no inconsiderable size. Small wonder is it that the total cost of the St. Gotthard line was nearly three hundred million francs, which represents about twelve million pounds.

At Chiasso the Swiss Federal authorities hand us over to the care of the Italian State Railways, after the Customs authorities have taken 18 minutes in which to examine our baggage, and a run of 32 miles, through Como, where a 2-minute stop is made, and across the Plain of Lombardy, brings us 63 minutes later to the great city of Milan. It is 1.55 p.m. and our journey of 230 miles, over these terrific gradients, has taken us 6 hrs. 43 min., whereas the very quickest journey possible between Basel and Milan in pre-war days was 8 hrs. 5 min. This shows how remarkable are the advantages derived by the passenger from the electrification.

The "*St. Gotthard Pullman*" has not yet finished its day's work, however. At 4.5 p.m. the same afternoon, it will be starting northward again out of Milan. Six o'clock in the evening will find it at Lugano and 9.15 at Lucerne; while the tired rolling stock, after 460 miles of travelling, will find its way into the great Central Station at Basel at 10.44 p.m. at night, there to disgorge its passengers into the night expresses leaving for all parts of Central and Western Europe.

Clearing the Railways of Snow



Courtesy] [*Southern Railway*

A Scene on the Alton and Winchester Line during the January snowstorms. Workmen are clearing a cutting in which a train was buried

Conquest of the Air—(*continued from page 207*)

one of whom was a lady, who were clinging to a slender screen of osier, for whom every second seemed counted, no one had fear. All tongues were mute, all faces were calm. Nadar held his wife, covering her with his body. Poor woman! Every shock seemed to break her to pieces.

"Jules Godard then tried and accomplished an act of sublime heroism. He clambered up into the netting, the shocks of which were so terrible that three times he fell on my head. At length he reached the cord of the valve, opened it, and the gas having a way of escape the monster ceased to rise, but it still shot along in a horizontal line with prodigious rapidity. There were we squatting down upon the frail osier car. 'Take care!' we cried, when a tree was in the way. We turned from it and the tree was broken; but the balloon was discharging its gas, and if the immense plain we were crossing had yet a few leagues, we were saved. But suddenly a forest appeared on the horizon; we must leap out at whatever risk, for the car would be dashed to pieces at the first collision with those trees. I got down into the car, and raising myself, I know not how, for I suffered from a wound in my knees, I jumped, and made I know not how many revolutions, and fell upon my head. After a minute's dizziness I rose. The car was then far off. . ."

The publicity that Nadar gave to his idea of a huge aerial screw had the effect of leading other inventive aeronauts, who did not wholly accept his views, to endeavour to apply the screw principle to lighter-than-air balloons. Next month we shall deal with these pioneer efforts to construct a practical mechanically propelled airship. (*To be continued*)

The New Meccano Ship-Coaler—

(*Continued from page 253*)

in turn, is bolted to one of the Triangular Plates 22. A Collar with set-screw keeps the Pulley in position. A 1½" × ½" Double Angle Strip 33 is bolted to the second hole at the inner end of one of the Strips 24.

The guide rail 29 consists of two 12½" Strips, one end of each Strip being clamped between two Flat Girders 21; this rail also passes between two 3½" Strips 19, and its end is curved downward to overhang the chute. The latter consists of two Sector Plates 30 joined by 2" Strips 31 and bolted to 5½" Angle Girders 32 on the underside of the rails 18.

Spinning Tops that Steer Ships

Wonders of the Gyro Compass

By H. F. Lane

(Concluded from last month)

THE Earth rotates about its axis once every 24 hours. Accordingly an observer standing at the pole (Fig. 4) would, relative to some fixed point in space, turn completely round in that period and at the end be facing in the same direction as that in which he had started. Thus, if he had been at the north pole and at the start facing directly towards some particular star, at the end of six hours the star would be on his right-hand; at the end of 12 hours it would be behind him; at the end of 18 hours it would be on his left-hand and at the end of 24 hours it would again be facing him.

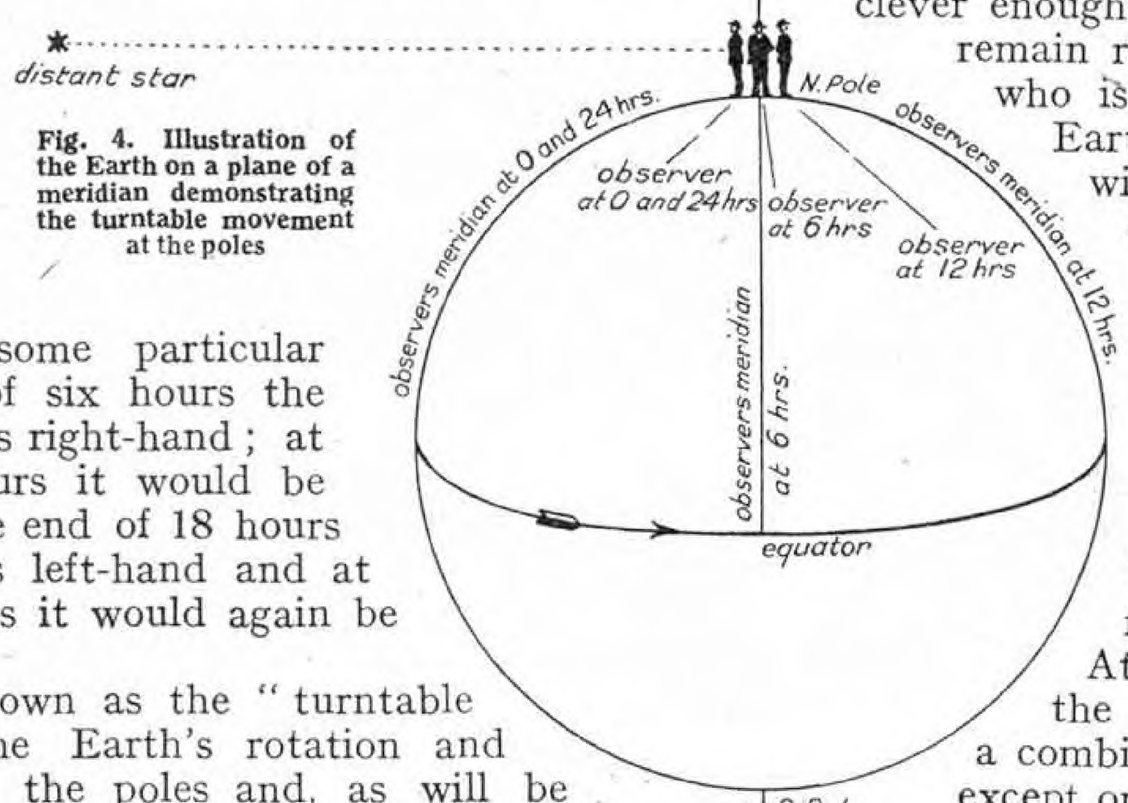


Fig. 4. Illustration of the Earth on a plane of a meridian demonstrating the turntable movement at the poles

This effect is known as the "turntable component" of the Earth's rotation and is a maximum at the poles and, as will be shown, zero at the equator.

An observer at the equator (Fig. 5) would—again relative to some fixed point in space—make a complete somersault and come upright again in 24 hours (although standing erect on the Earth's surface throughout). We may note our habit of calling Australia the Antipodes. Since the soles of our boots both in England and in Australia are towards the centre of the earth we are, as it were, standing sole to sole but separated by the Earth between us; and since the pull of gravity is towards the centre of the Earth, we each appear to be standing upright as regards our immediate neighbourhood.

Suppose that our observer had been facing towards the Pole Star. He would continue to face that way, that is there would be no turntable movement, but at the end of 12 hours his feet would be pointing in that direction in space in which his head had pointed at the commencement, and at the end of 24 hours he would have regained his original direction.

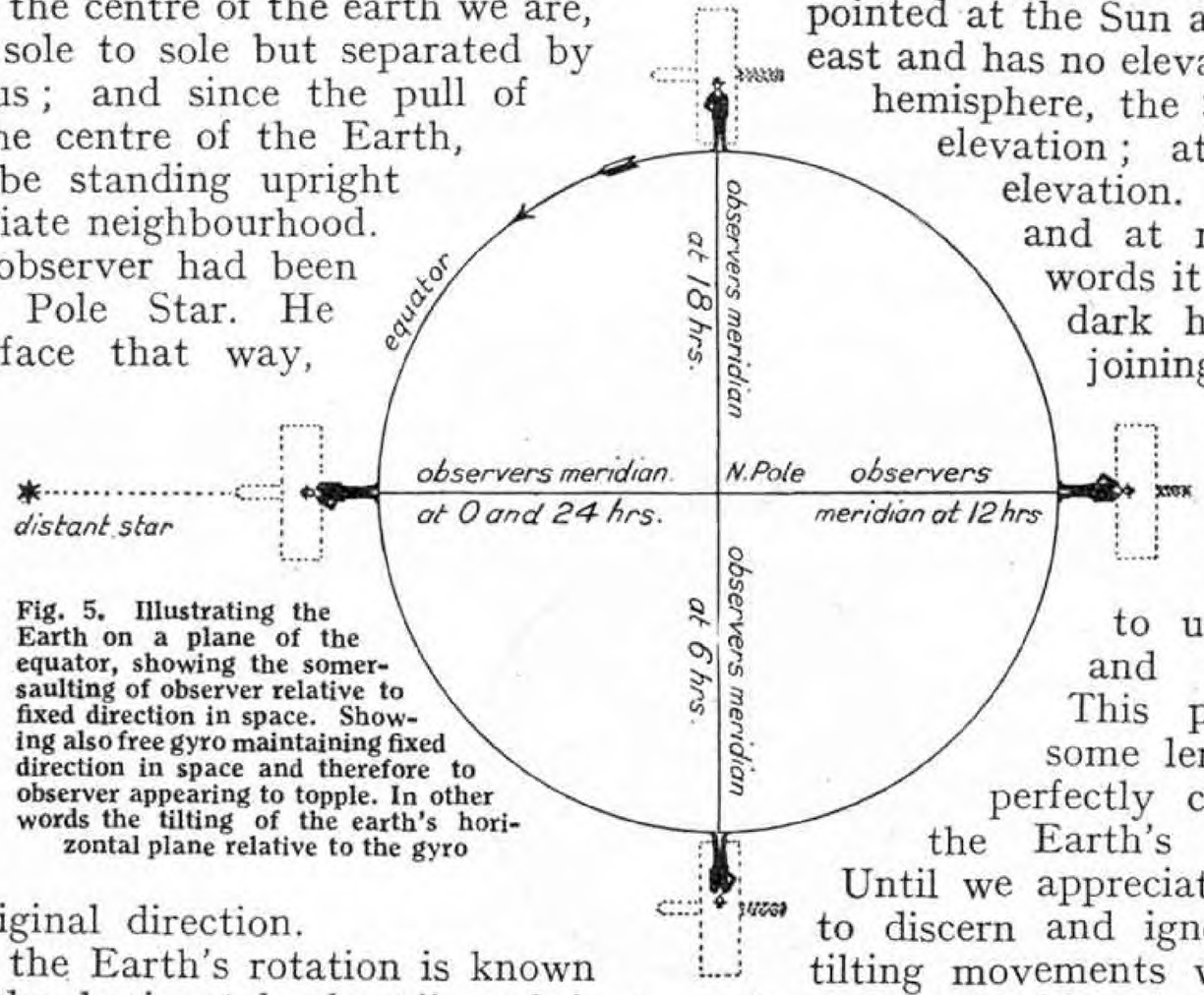


Fig. 5. Illustrating the Earth on a plane of the equator, showing the somersaulting of observer relative to fixed direction in space. Showing also free gyro maintaining fixed direction in space and therefore to observer appearing to topple. In other words the tilting of the earth's horizontal plane relative to the gyro

This component of the Earth's rotation is known as the "tilting of the horizontal plane" and is a maximum at the equator, while we have already seen that it is zero at the poles.

Consequently, a free gyro spinning with its axis horizontal at the pole (Fig. 6) will, by retaining its direction fixed in space, appear to an observer at the pole (who is carried round by the Earth) to veer one complete revolution in the horizontal plane every 24 hours. Actually the free gyro has, as it were, been clever enough to disregard the Earth's motion and remain rigid in space; but to the observer—who is unaware of his own rotation, since Earth and his surroundings are turning with him—the gyro will seem to have done the turning.

Similarly, a free gyro at the equator with its axis at the beginning horizontal and in the east-west line (Fig. 5), will appear to topple, or turn a complete somersault, every 24 hours. Here again the gyro actually has remained rigid and the observer has done the toppling, relative not to Earth but to space.

At any intermediate latitude between the pole and the equator the effect will be a combination of these two; that is, anywhere except on the equator a free gyro will not turn a complete somersault but, after toppling, an amount of it depending on the latitude, will begin to return to its original position. Similarly, anywhere except at the poles, the free gyro will not veer a complete revolution but, at some period before reaching 90° deflection, will begin to assume its original direction.

Now consider a free gyro, one end of whose axis is pointed at the Sun as it rises. The Sun rises in the east and has no elevation. At noon, in the northern hemisphere, the Sun is south and at maximum elevation; at sunset it is west and at no elevation. At midnight the Sun is south and at maximum depression—in other words it is below the horizon, hence the dark hours of night. Now the line joining the Earth to the Sun is a fixed direction in space and therefore the axis of the free gyro, if started pointing to the Sun, will continue to point to it and in following its movements will, to us on Earth, appear to topple and veer in a 24-hour period. This point has been elaborated at some length in order to try to make perfectly clear what is the reaction of the Earth's rotation on the free gyro.

Until we appreciate the ability of the free gyro to discern and ignore the Earth's turntable and tilting movements we cannot hope to understand how the addition of a suitable gravity control converts the free gyro into a compass.

Let a free gyro be mounted at some latitude between the pole and the equator but with its axis, instead of being

horizontal, parallel to the Earth's axis (Fig. 7). The axis therefore will lie in the plane of the meridian, but will be tilted up, relative to the horizontal at the place, an amount equal to the latitude. In such a case the plane of spin of the Earth is parallel to the plane of spin of the gyro, whose plane of spin in space is therefore unaffected by the Earth's motion, which conveys to it a motion of translation only. The horizontal plane is tilting about an axis lying in the same plane as the gyro axis, which is therefore unaffected by it; and the turntable motion is taking place in a plane parallel to the gyro's plane of spin so that this also has no effect. Hence the gyro axis will remain in the plane of the meridian, and further, by its tilt, it will define the latitude.

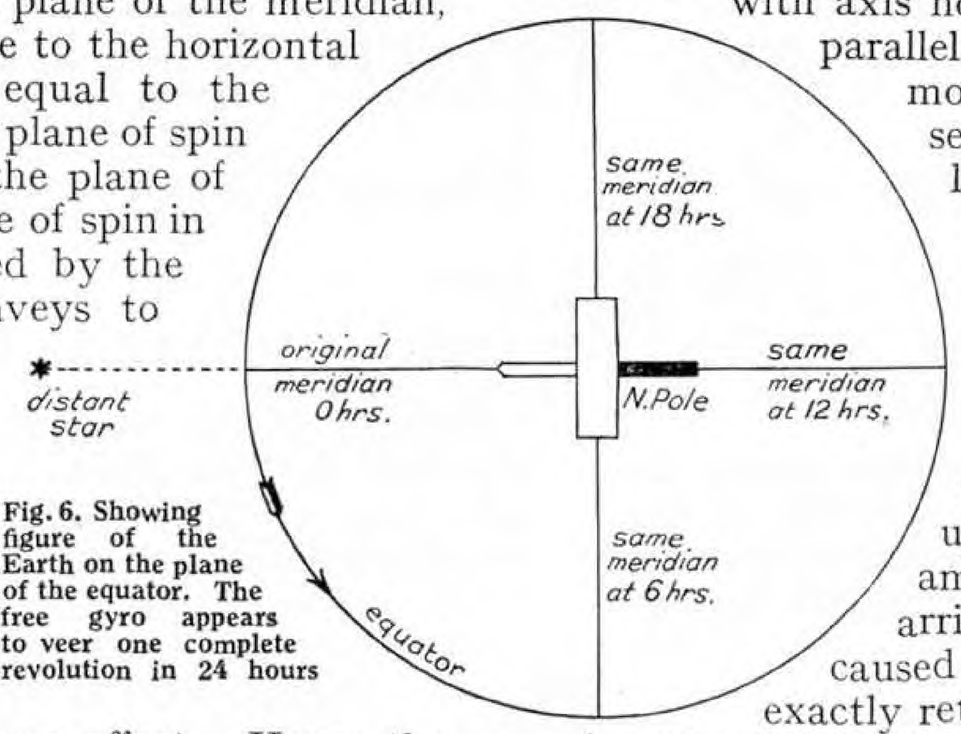


Fig. 6. Showing figure of the Earth on the plane of the equator. The free gyro appears to veer one complete revolution in 24 hours

Such an instrument, if a *perfectly* free gyro were possible, would act as a compass, but actually friction, however much reduced, would cause it to wander and it would have no tendency to return.

Consider a gyro mounted rather more elaborately as shown last month in Fig. 1. The wheel is enclosed inside a casing. Casing and wheel can tilt together about a horizontal axis and the whole mounting can rotate about a vertical one. We therefore have the three degrees of freedom—to spin, to tilt and to veer—but the tilting freedom is available only at the expense of lifting a weight hung from the bottom of the casing. As long as the axis is horizontal, the weight is vertically beneath the horizontal pivots and is exerting no effect on the gyro. If the axis be tilted, however, the weight will be raised and in attempting to return to its lowest position will be exerting a force on the axis trying to tilt it down. Precession, as we know, will not allow the weight to lower, but will cause the whole system to veer in the horizontal plane.

Imagine such a gyro spinning with axis horizontal and in the meridian at some intermediate latitude between the pole and the equator. A certain proportion, dependent on the latitude, of the turntable component of Earth's rotation is present, tending to cause the gyro axis, relative to Earth, to drift east away from the meridian or, relative to space, the meridian to lag behind the rigid axis, because with axis horizontal the plane of spin is no longer parallel to the plane in which the turntable movement is acting and this, as we have seen, would cause a movement of translation only. Hence to remain in the meridian the gyro must have a small horizontal precession that will exactly cancel or counterbalance this drift.

In order to obtain this we must apply a torque in the vertical plane, such as is supplied by the weight if the axis be tilted. Therefore if we tilt up the N. end of the axis the requisite amount (depending on the latitude) we arrive at a resting position, the precession caused by the weight at that particular tilt exactly retaining the axis in the meridian against the drift. By employing a suitably heavy weight the tilt will be very small (minutes of arc only) as opposed to the free gyro where tilt had to equal latitude; and yet in theory sufficient to overcome not only the drift but the inevitable friction of the mounting, and remain in equilibrium.

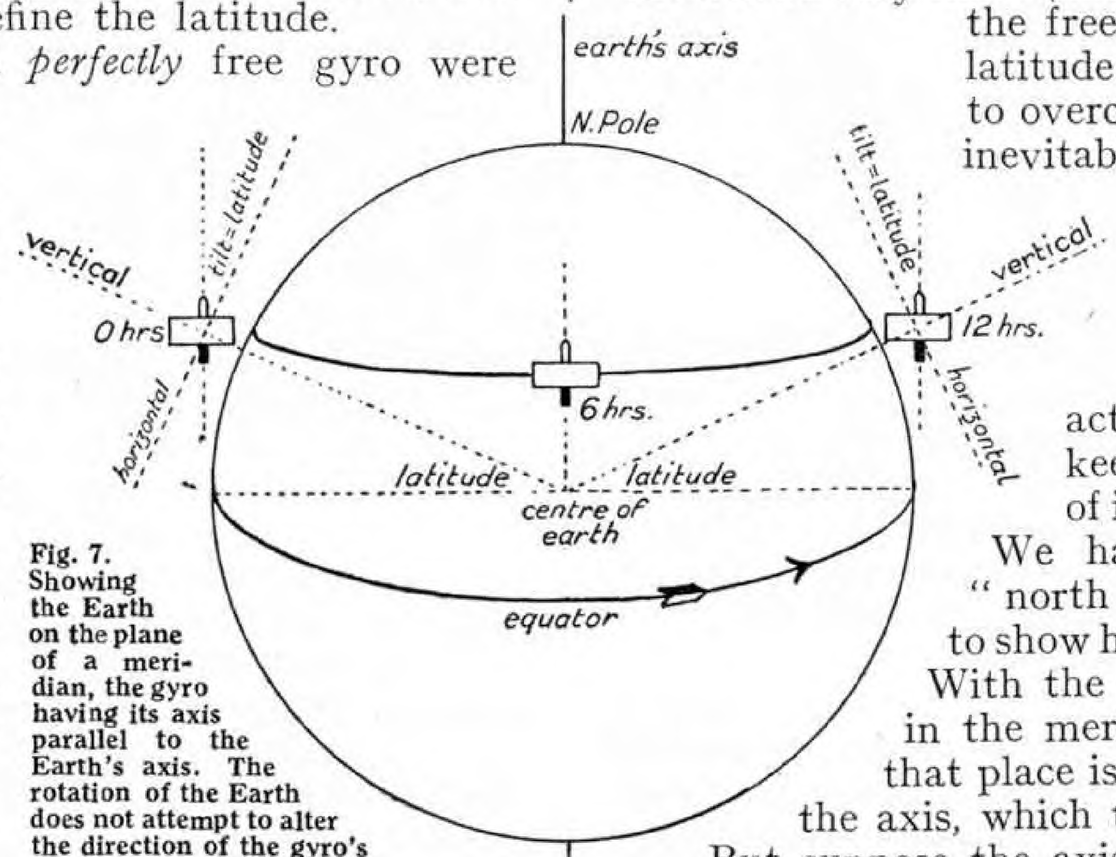


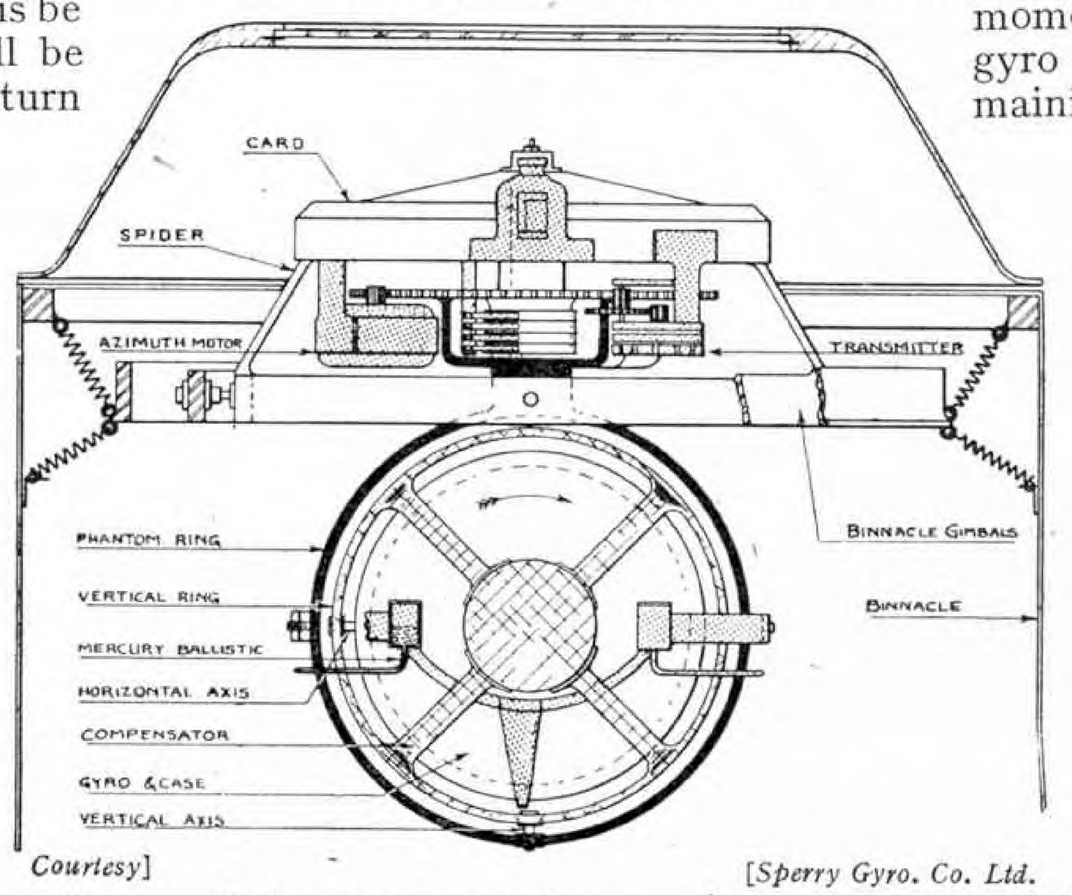
Fig. 7. Showing the Earth on the plane of a meridian, the gyro having its axis parallel to the Earth's axis. The rotation of the Earth does not attempt to alter the direction of the gyro's axis in space. Its axis therefore remains in the meridian (i.e. always pointing north) but tilted up an amount equal to latitude

Thus we are approaching the evolution of our compass—the axis to all intents and purposes horizontal, though actually its infinitesimal tilt is keeping it in the meridian instead of it maintaining rigidity in space.

We have now made the compass "north retaining;" we will go on to show how it is made "north-seeking." With the axis so nearly horizontal and in the meridian, the horizontal plane at that place is tilting about a line parallel to the axis, which therefore is unable to sense it.

But suppose the axis to be at right angles to the meridian, that is with its original N. end pointing east. The axis is now as it were lying across the tilting of the plane, which on the E. side of the meridian is tilting away from the axis and on the W. side is tilting towards it.

We can understand this more readily by returning for a moment to the instance of the free gyro pointing at the Sun. In remaining pointed at the Sun and thereby maintaining its rigidity in space, to us on Earth the axis appears to tilt up as the Sun rises. That is to say, to the gyro the horizontal plane of the Earth has tilted down, which is actually the reason why the Sun rises at all. Thus, reverting to the pendulous gyro, the amount of tilt on the N. end of the axis has increased relative to Earth's horizontal. Therefore the weight is exerting a greater force and the rate of precession will increase, so that the pendulous gyro, instead of remaining pointing to the Sun, will rush back to the meridian.



Courtesy [*Sperry Gyro. Co. Ltd.*

Fig. 8. North elevation of Sperry Compass showing details of construction

The reader is again reminded that the gyro

is exerting forces acting in planes that try to remain unchanged in space, whereas Earth's vertical plane through the gyro axis and the weight is being carried round by the rotation of the Earth. The interaction between gravity and gyroscopic rigidity is thus constantly changing unless the gyro is in the meridian and at its correct tilt, when it will be in a state of equilibrium. In any other position the changing relations are calling into play forces that set up precession tending to seek equilibrium once more.

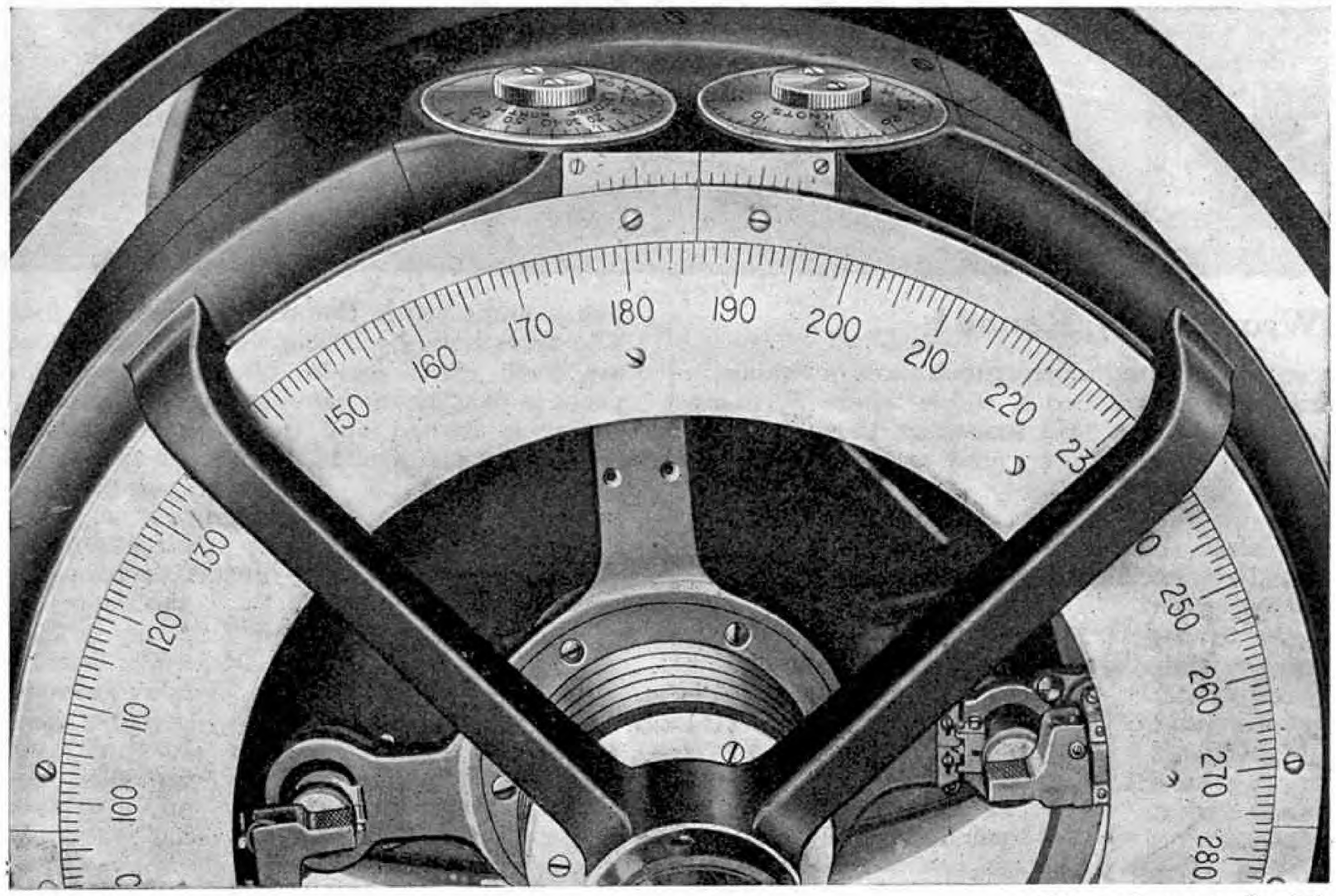
We left the compass swinging back to the meridian on account of an increased tilt. When it reaches the meridian it will, of course, still have this excess of tilt; that is, the precession will be in excess of that required to balance the drift and the axis will swing west of the meridian. As soon as it has crossed the meridian, however, it begins to sense the upward tilting W. of the meridian of the horizontal plane —which is the reason why the Sun sets. In other words, the tilt on the axis decreases and hence the precession decreases, until the axis becomes horizontal and the westerly precession ceases. But the axis is still W. of the meridian, still sensing the upward tilt of the plane, and hence the decrease in the tilt of the gyro axis continues and becomes a tilt down below the horizontal, setting up easterly precession, so that the axis rushes back to the meridian once more.

Crossing the meridian with this decreased tilt, the easterly precession continues until the downward tilt of Earth's horizontal east of the meridian restores the gyro axis to the horizontal. This is the point from which we started, and from here the whole cycle of operations would repeat itself indefinitely.

We have now advanced a stage further. In addition to possessing a resting position practically horizontal and in the meridian, the instrument, if displaced, will trace out an elliptical path round its resting position, having the resting position as centre. The excess of tilt referred to above as causing the precession, though sensed by the gyro, is inappreciable to the eye; so that our compass remains for all practical purposes horizontal, and since it is so far swinging an equal amount on either side of the meridian we can determine the meridian by averaging the readings.

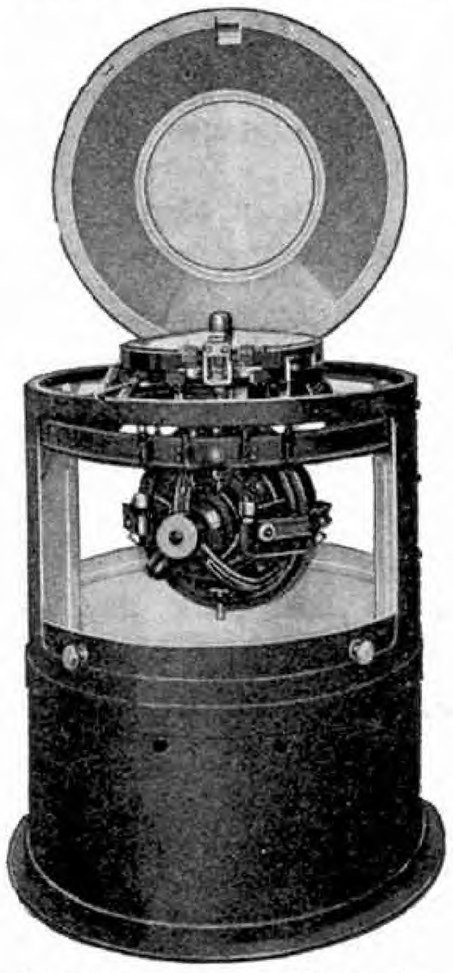
It is not necessary to do this in the actual compass as used in ships, however, because in it these oscillations are damped down and rapidly become zero—in other words the compass tries to stay in the meridian and if disturbed at once works its way back again.

The actual compass used in ships is a highly complicated but very beautiful and fascinating piece of mechanism. In it the spinning wheel is actually the rotor of a high-speed motor. Figure 8 shows a diagrammatic elevation of the North end of the Sperry Gyroscopic Compass, which is in general use throughout the British Navy. It costs about £2,000, and the drawing shows it about one-tenth full size. The rotor is enclosed within a casing, which is supported by very delicate ball-bearing horizontal pivots. It is thus free to spin and to tilt. To give it freedom to veer also, the horizontal pivots are formed on a vertical ring that is hung by 17 torsionless strands of fine wire from a horizontal ball-bearing in the upper part of still another vertical ring known as the phantom. It is prevented from swinging about in the phantom by a guide bearing at the bottom of the latter, which, however, takes no weight.



Courtesy [*Sperry Gyroscope Co. Ltd.*

Dial of the Sperry Gyro-compass



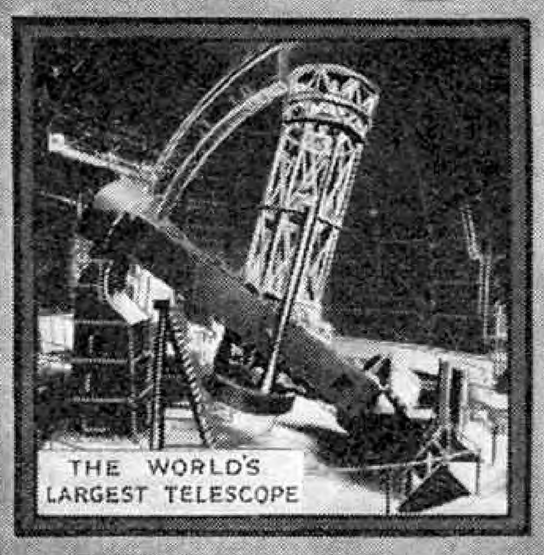
Courtesy [*Sperry Co.*

Sperry Master Compass

By means of a very sensitive electrical follow-up system operated by the azimuth motor, the phantom is kept constantly in line with the vertical ring, following it like a shadow wherever it moves. If the gyro-casing veers the very slightest amount, causing an infinitesimal torsion in the suspension wire and an infinitesimal movement of the ball-bearings in the phantom ring, the electric follow-up immediately operates and brings the phantom once more into line with the vertical ring, i.e., into line with the casing and rotor, whereby friction is unable to impose any torque in the horizontal plane on the sensitive axis. The phantom is also mounted in ball-bearings and suspended from the spider, which, by means of spring-damped gimbal rings, is secured to the framework of the ship.

A mercury ballistic, free to tilt about delicate horizontal pivots mounted in the phantom ring, and co-axial with those supporting the casing in the vertical ring, takes the place of the weight, and from it an arm descends, connected by another delicate bearing to the lower part of the casing, so that casing and ballistic tilt together, and the influence of the ballistic when tilted is transmitted to the casing (partial suppression of freedom about the horizontal axis).

We have spoken of the gyro casing veering in the spider. Actually the gyro remains pointing (*Continued on page 225*)



Of General Interest

The Wrong Way Round!

A Chinese visitor recently inspected a prize stock farm in France. He made no comments until he reached a stable where 20 fine horses were standing in their stalls. He looked at these horses earnestly for a moment and then turned round and said to the owner :—

"I cannot understand why it is that you Europeans always put your animals in their stalls the wrong way round."

"The wrong way round!" exclaimed the astonished breeder.

"Exactly. You place your animals with their noses to the wall. They cannot see anything and therefore are easily frightened, with the result that they are liable to kick anyone who approaches them. In my country we turn them round so they can see what is going on and they are always quiet and harmless. You Westerners always start at the wrong end of things!"

Another Illusion Destroyed

Eskimos are usually pictured as wrapped in furs to retain their bodily heat and continuously chewing heat-producing foods such as fat and blubber. A doctor who accompanied MacMillan's most recent Arctic Expedition made a special study of the diet of the Eskimos in Greenland and in the North of Labrador, and he has issued a report that completely upsets these notions. So far from eating large quantities of fat, the Eskimo apparently values it mainly for making oil for lamps and to a smaller extent for cooking purposes. Fish and the flesh of the whale, seal, bear and caribou form the main food of the Eskimo and he prefers to eat his meat raw. Liver is regarded as a special luxury except in the case of the polar bear, the liver of which is for some mysterious reason so poisonous that even dogs on the verge of starvation refuse to eat it.

The Eskimo evidently benefits from the vitamins absorbed by him as a result of his raw flesh diet, for in Greenland scurvy and rickets are practically unknown. In Labrador on the other hand meat is often cooked and a certain amount of tinned food is eaten, and among the inhabitants both these diseases are common.

Yachting in a Ford Car

The ubiquitous "Ford" has been used for a great variety of purposes and often in remarkable circumstances, but it is probable that its inventor never dreamed of one of his cars being turned into a yacht. To call the product a yacht is perhaps an exaggeration for it is scarcely a thing of beauty; but it "goes," which after all is the main point.

The car has been mounted on a float that looks suspiciously like a punt, with the rear axle-casing fixed low down behind. The tyres have been removed from the wheels and in their place are fixed eight paddle blades. The operation of driving the yacht is exactly the same as that of driving the car on land. The engine is started and the back wheels revolve, but instead of turning on the ground they turn the paddle wheels and propel the vessel forward. Steering is accomplished by the aid of the usual wheel geared to a rudder.

This is a novel but quite practical solution of the difficulty of quickly providing cheap means of transport between points on the shores of a lake in comparatively wild districts, and it is quite possible that this pioneer boat may have many imitators.

Some day a genius will come forward and fix wings and a propeller to a Ford car and make it fly!

Over a Hundred Years Ago!

"The poor of Brighton have had a fat bullock distributed amongst them, as usual at this season, by order of their Rector."—"HANTS ADVERTISER," 15th Jan., 1827.

News from the Arctic

"ARCTIC DISCOVERY.—Reports have reached London that Captain Franklin has accomplished the objects of his overland expedition, and has fallen in with the '*Blossom*,' sent for the purpose of meeting him in Behring Straits."—"SUNDAY TIMES," 25th Feb., 1827.

Tribute to British Workmanship

"The Suspension-bridge thrown over the Thames at Hammersmith is daily visited by the admirers of mechanism. A chain bridge so near the metropolis is a novelty, and during the fine weather the works are attractive. The bridge in its present state forms a remarkable object, displaying the great superiority acquired by British artisans in the manufacture of ironwork."—"THE TIMES," 9th Jan., 1827.

Perils of Skating!

"About 15 days since, the skaters and the spectators of their sport had collected in great numbers on one of the basins in the park of Versailles, when a sudden crack, and the breaking of ice which instantly succeeded let in the old men, women and children.

"The water of this basin, which was of little depth, being absorbed by the pockets of the gentlemen and the petticoats of the ladies, they easily regained the bank, and it seemed as if nothing had happened. The only regret attending this event is that it has left one of the prettiest basins of the park dry."—"THE TIMES," 4th Feb., 1827.

Miles of Books!

The British Museum, described by John Ruskin as the "grandest concentration of human knowledge in the world," represents nearly two centuries' work, having been begun in 1753 by the purchase of the library and collection of Sir Hans Sloane. It is particularly rich in relics of the prehistoric world and ancient civilizations and contains the most famous sculptures, vases and jewelry—also an original copy of Magna Charta and many other precious manuscripts besides rare books innumerable, the library comprising some 4,000,000 volumes. The Reading Room, which occupies the central quadrangle, has a beautiful dome and although "Readers only" are allowed inside, it may be viewed from the doorway. The building and courtyard occupy an area of seven acres.

The galleries in which the books are stored are made entirely of iron and the invention of sliding shelves has so greatly increased the capacity that there are no fewer than 46 miles of shelving available! The official estimate of the number of books in the library is well over 2,000,000, but it is impossible to say how many there are in reality, as many pamphlets, etc., are bound together.

The necessity for this enormous length of shelving will be realised when it is remembered that a copy of every book published in the United Kingdom must be delivered to the British Museum within one month of publication. Thousands of books are published yearly and the task of receiving and accommodating the avalanche is no light one. Readers will be interested to learn that a copy of the "*M.M.*" is sent regularly to be deposited in this great national library.

Other libraries sharing the privilege of receiving a copy of all new books published are the Bodleian Library, Oxford, the University Library, Cambridge, the Advocates' Library, Edinburgh, and the library of Trinity College, Dublin.

Deceiving the Woodpeckers

An interesting story comes from the Canadian Rockies concerning an assemblage of woodpeckers. In the Autumn of 1926 a huge hotel was being constructed at Banff and large numbers of structural steel workers were engaged in erecting the steel work for this palatial hotel. There was the loud clanging of steel as the heavy girders were lifted and guided into place. Winches rattled and engines hissed incessantly, but above all other sounds rose the staccato "rat-tat-tat" of scores of pneumatic rivetting hammers. This sound penetrated far up the valley and re-echoed from cliff and crag shattering the silence of the deep green woods that clothed the valleys and mountain slopes.

Throughout this extensive forest area around Banff many woodpeckers are to be found at all seasons of the year. These feathered foresters heard the rivetters at work and interpreted the noise as being the noise of a host of tree-boring birds hammering and drilling in the bark and timber of Douglas Fir and Spruce. They instinctively hastened to the source of the sound, confident that a keen eyed and enterprising member of the tribe had discovered an army of tree-infesting grubs and that there would be a feast for all who cared to answer the summons broadcast so clearly.

The Dileated Woodpecker, a large black plumaged bird with crest of scarlet vivid as huntman's coat, flew through the woods like a fiery torch and caused the dim aisles to echo with his loud and raucous cry. Downy and Hairy Woodpeckers, lesser birds in the ancient order of foresters, clung to the gnarled bark of trees and with heads aslant, hearkened querulously to this strange drumming of hammers on steel.

Such an assemblage of Woodpeckers had never before been seen in the valley of the Bow. The woods seemed alive with birds of this breed. Unlike most conventions held at Banff, this one could scarcely be termed a success. No doubt the birds were disillusioned and deeply disappointed that the promised feast did not materialise. Nevertheless there must have been compensation in the number of family re-unions made possible by the call of the hammers that fashioned the framework of a great hotel in the scenic heart of the Rockies!



A fine photograph of a Green Woodpecker

A Swiss Mountain that Threatens to Fall

The erratic behaviour of a mountain in Switzerland is creating something like consternation among the people in the surrounding villages. These unfortunate folk have been ordered to leave their homes and all building and tree-felling operations in the vicinity have been suspended because the mountain is actually threatening to fall!

The mountain that is causing all this disturbance is Monte Arbino. It is 5,560 ft. in height and is situated three miles to the east of Bellinzona, a small town in the valley of the River Ticino, a few miles above the head of the famous Lake Maggiore. Between the years 1888 and 1905 the summit moved 6 ft. but since then its rate of movement has quickened and it is now travelling at the rate of 1 ft. per year. In addition the mountain seems to be settling down for its height decreased 14 in. during 1926.

The large cracks and crevices in the mountainside have widened considerably during the past few years and falls of rock and earth have become so frequent that great fears are entertained of the imminent collapse of the whole mountain. Nothing can be done to prevent this from taking place and it is only possible to minimise loss of life in the event of such a catastrophe by removing the inhabitants from the valley into which the mountain is likely to crash. Bellinzona itself is fortunately protected by an immense granite bridge that intervenes between it and the mountain.

Moving mountains are not unknown in Great Britain and more especially in South Wales. A recent instance is that of the Nantymynydd Mountain, the foot of which was driven forward last month as the result of several extensive landslides believed to have been caused by abnormal rains. It is possible that this trouble may develop still further, but it cannot be compared in regard to danger with the threatened fall of the Swiss mountain. There is also the difference that the movement of the Welsh mountain is due entirely to landslides, whereas the very rock of which Monte Arbino is composed appears to be on the point of breaking up. If this does occur something more than a mere landslide will follow and the possible spectacle of rocks weighing hundreds of tons crashing into the valley will be awe-inspiring.

A Schoolhouse on Wheels

To meet the peculiar conditions of the section between Cartier and White River on the Canadian Pacific Railway's system in the backwoods of Ontario, north of Lake Superior, a schoolhouse on wheels has been introduced. A railway car has been transformed into a schoolhouse, modern and complete in every particular, by the company, while the Ontario Department of Education co-operate by paying the teacher's salary and providing and maintaining the scholastic equipment.

The actual schoolroom contains 12 desks and seats of varying sizes, blackboards, roller maps, a globe, and well-filled book-cases. Adjoining the schoolroom is the teacher's bedroom, for he travels continually with the train, and beyond that is the kitchen, equipped with everything from a refrigerator to the regulation cook stove of C.P.R. dining cars.

The pupils in this unique school could not be otherwise reached, being the children of prospectors, lumbermen, trappers, etc. For the most part these people are foreign born, and the work done by this travelling school is really the initial step in a wide movement of national assimilation. The car is moved from one point to another on the Canadian Pacific division, the arrangement being that it will remain at one point not less than three and not more than six days, when enough home work is left with the pupils to occupy them until the car completes its circuit and returns to the starting point. The ages of the pupils attending classes range from five to 20 years, and about 90 per cent. of them have had no previous schooling. Night classes have also been inaugurated for adults, and in such cases whole families attend, the children during the day and the parents at night.

The first year's operation of this pioneer car has given the utmost satisfaction all round.

Smacks by the Million!

School work to-day is easier for teachers than it used to be, if all the old-timers were like John James Hauberle, who "taught school" in America more than 100 years ago. "Taught and caned school" is perhaps a better description of his activities, for he is recorded to have administered nearly a million strokes with sticks or rods to his unfortunate pupils during his career of 51 years! Teaching in the good old days evidently involved physical as well as mental effort.

Blows with one hand during the same period numbered 136,715; boxes on the ear 7,905, and "sundry reminders" 12,342. Mr. Hauberle stirred up a pupil with a rap on the head on no fewer than 1,115,000 occasions—a number that suggests great watchfulness on his part or appalling inattention on the part of the recipients, for it averages 70 for each school day without taking holidays into account!

The average daily number of impulses to learning given by this indefatigable instructor was 140, making a total number during his 51 years' service of 2,236,206. This figure does not take into account the number of times he made boys kneel on peas or on three-cornered blocks of wood. These were evidently regarded as serious punishments not to be administered lightly, for he made use of them only once in a fortnight!

Electricity Applied to Meccano

V.—A Meccano Shocking Coil, Electro-magnet, and Signal

These articles are intended to draw every Meccano boy's attention to the numerous fascinating uses to which the Meccano electrical parts may be put. The first two articles of the series dealt with the elementary principles of electricity, and the second and third articles described various Meccano switches, a coil-winding machine, and a Meccano electric telegraph system. Below we describe an electro-magnet of the type that can be used in model cranes, etc., a shocking coil, and an electrically-operated semaphore railway signal. All these models are constructed from a few ordinary Meccano parts used in conjunction with the special electrical accessories.

THE importance of the electro-magnet in nearly all electrical appliances was remarked upon in the article in this series which appeared in the December, 1927, "*M.M.*," and in the course of the article it was shown how its magnetic field was similar to that of an ordinary bar-magnet of the permanent type. Hence the former type of magnet may be substituted with advantage for the latter. A permanent magnet is liable to become de-magnetised through rough usage and its power is extremely limited, whereas the effect of an electro-magnet may be very powerful indeed. Moreover, the magnetic force of the latter type may be turned on or off at will.

An electro-magnet depends for its lifting power upon two factors, namely, the number of turns of wire constituting the magnet winding, and the number of amperes—that is, the amount of current—in the turns. A current of ten amps. flowing through ten turns of wire will produce a weak magnetic effect, but if we increase the number of turns to one hundred, a magnet ten times more powerful will be obtained. In technical terms the power of a magnet is gauged by the number of "ampere turns," which measurement is obtained by multiplying the number of amperes flowing along the wire by the number of turns in the magnet.

The above will become more clear if we recall that a straight conductor is surrounded by a magnetic field, as explained in a previous article. If the conductor is wound into a close spiral the magnetic field of each adjacent turn will be augmented, thus producing a greatly enhanced effect.

Having briefly sketched the elementary principles of the electro magnet we may describe the construction of a working model in Meccano. Nearly all the models described in this article, and the majority of those that will appear in subsequent issues, will embody a magnetic coil in some form or other, but the model about to be described is a simple electro-magnet of the type that in actual practice is sometimes attached to the hoisting hook of a crane and used for lifting masses of iron and steel, etc.

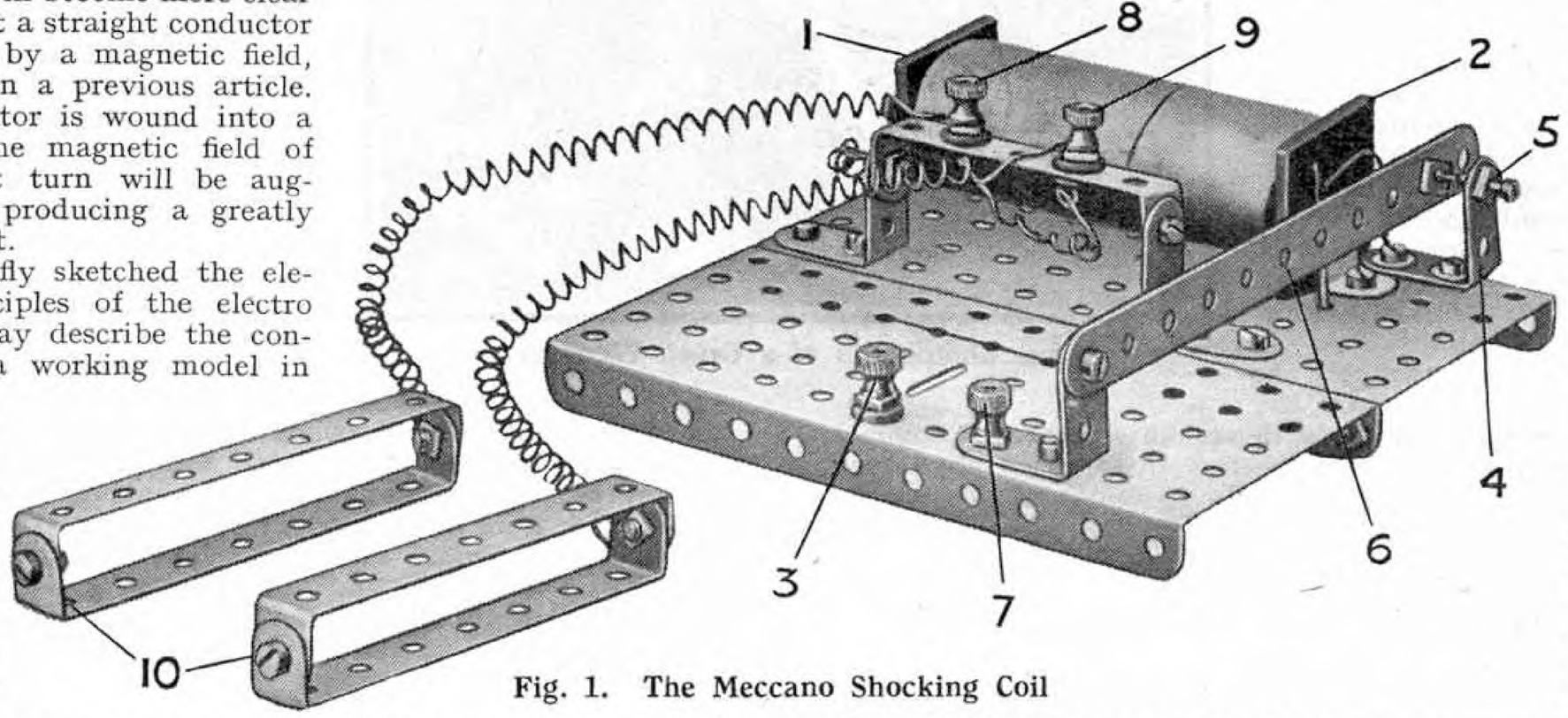


Fig. 1. The Meccano Shocking Coil

The Meccano Electro-magnet

To construct the Meccano electro-magnet (Fig. 2) first wind two Bobbins to full capacity with either 23 or 26 SWG wire. A magnet wound with 23 gauge wire will be more powerful than one wound with 26 gauge wire. This is due to the fact that the "23" wire has a lower resistance per unit of length than the "26"; therefore, a larger flow of current will be carried by the former, and a more powerful magnetic effect will be produced from a given voltage.

Some interesting results may be tabulated to show the relative weights that can be lifted by magnets wound with 26 and 23 SWG copper wire, the same voltage being used in each case, of course. In the Meccano models it will be found that magnets wound with 23 SWG wire have a fewer number of turns than those wound with the other wire. This, of course, is due to the fact that the slightly larger diameter of the wire prevents the same number of turns being accommodated on the Meccano Bobbin. A magnet wound with 26 gauge wire has a higher resistance than one wound with 23 wire, so we must increase the applied voltage if we wish to maintain the current at the same value as in the lower resistance coil assuming, of course, that both magnets have equal lengths of wire used in each case. This is in accordance with the ampere-turns law quoted above.

The Bobbins of the Meccano magnet are attached to the yoke 1, which is composed of three 1½" Strips, by the Pole Pieces 2. A wire protruding from one of the magnet coils should be connected to one wire of the second coil, and in order to select the proper wires for connection, it should be imagined that the current, starting from the input end (represented by the wire attached to the accumulator) of the first coil, flows round that coil in a clockwise direction. It then passes to the second coil and flows round it in an anti-clockwise direction. By connecting the two magnets in this way, one is given a North and the other a South polarity.

The two leads to the coils should be of sufficient length to permit the magnet being raised and lowered by the crane. The hoisting cord may be rove round the 1" Pulley 3, which turns upon a 1" Axle Rod journalled in a Cranked Bent Strip 4 bolted to the yoke 1.

The magnet may be fitted to almost any Meccano Crane, and much fun and interest can be gained by using it in place of the hoisting hook. The load is dropped whenever required by switching off the current.

Induction or Shocking Coil

In the article on "The Dynamo and the Electric Motor" in the "*M.M.*" for December, 1927, reference was made to the great discovery by Faraday of electrical induction. As there stated (page 1083) the first step in the discovery was the demonstration that a current of electricity could be induced in a coil of wire either by moving the coil towards or away from a magnet. This discovery led to the construction of the dynamo.

The induction of a current is due to the cutting across of the lines of force of the magnet by the coil. Instead of the magnet a solenoid or spiral coil of wire carrying a current may be used to produce the lines of force and Faraday actually used a solenoid in this manner. A further step was taken when the relative positions of the coils were left unaltered and the current in one of them was started and stopped alternately. This led to the invention of the induction coil.

In its usual form this instrument consists of two coils, one wound outside the other. The inner coil is called the primary coil, as it carries the current used to produce the lines of magnetic force, while the outer coil is the one in which the current is induced, and is called the secondary coil.

When the current is switched on in the primary coil the latter becomes an electro-magnet and lines of force come into existence. These are cut across by the secondary coil, so that the effect is exactly the same as if a coil carrying a current were moved towards the secondary. If the current is now switched off an induced current in the opposite direction is produced in exactly the same manner. By switching on and off with great rapidity by means

of a current interrupter, an alternating current is induced in the secondary coil.

The great value of the principle of induction is that the voltage of the induced current may be increased by using more turns of wire in the secondary coil, the voltage set up being nearly proportionate to the relative number of turns in the two coils. If the primary coil has 100 turns and the secondary coil 2,500 turns, then the voltage in the secondary circuit will be nearly 25 times as great as that in the primary circuit. In the model to be described the primary circuit consists of about 200 turns and the secondary of about 1,500. This gives a voltage ratio of about seven, and thus the use of a four-volt accumulator will produce an alternating current in the secondary of approximately 28 volts.

The instrument is made more efficient by inserting a core of soft iron within the primary, as this causes the lines of force to be crowded into a smaller area. The core also plays an important part in the type of interrupter used in the present model. At one portion of the circuit the primary current is made to pass from the point of a screw to a vibrating strip, the latter being close to one end of the core. Immediately the current is switched on the core becomes an electro-magnet and attracts the strip towards it, thus breaking the connection with the point of the screw. The primary current is thereby cut off and as the core loses its magnetism the vibrating strip swings back and makes contact once more with the screw. The current is thus restarted, only to be interrupted again immediately, so that the device switches the primary current on and off automatically in the manner required.

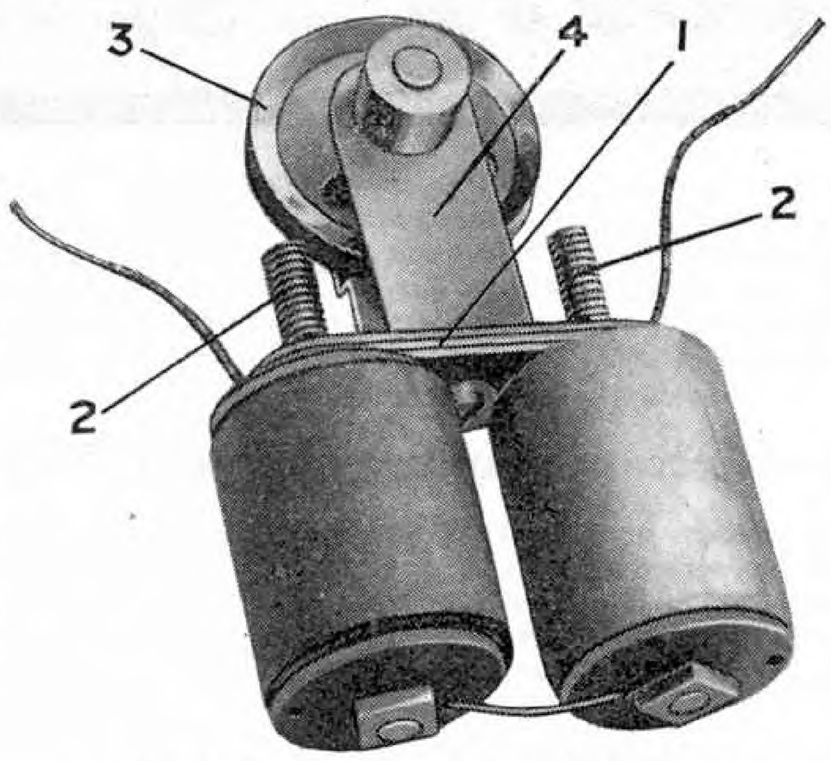


Fig. 2. The Meccano Electro-magnet

Construction of the Model

Let us now turn our attention to the construction of the Meccano model. The core of the primary consists of four 4½″ Strips laid one upon the other, on which are pressed two Coil Cheeks 1 and 2. These Strips are carefully covered with insulating tape or stout brown paper to prevent their sharp edges cutting the insulation of the winding.

The primary winding, which is wound on the core, consists of two layers containing approximately 200 turns of No. 23 SWG copper wire, the two ends of the wire being led through the two small holes in the Cheek 2. Care should be taken to wind the turns on evenly. When completed, the primary winding must be covered with insulating tape, etc., to insulate it from the secondary winding. This must be done carefully as the whole coil will have to be dismantled if a breakdown in the insulation occurs.

The secondary winding consists of ten to twelve layers of 26 SWG wire, or approximately 1,500 turns. It is advisable to cover this also with insulating tape or paper, etc., to add to the appearance of the completed coil.

The coil is bolted to the Flanged Plate forming the base of the model by two Double Brackets secured at each end of the core. One end of the primary winding is brought below the base plate to the insulated terminal 3, and the other end is connected to the 1″×1″ Angle Bracket 4, which is insulated from the Flanged Plate.

This Angle Bracket carries a special Meccano silver-tipped Contact Screw 5, a similar screw being carried on the vibrating 5½″ Strip 6. This forms the interrupter. The 1″×1″ Angle Bracket to which the 5½″ Strip 6 is bolted, has a Terminal 7 in metallic contact with it. The Accumulator is joined across the terminals 3 and 7, thus completing the primary circuit. The two ends of the secondary winding are brought out to the insulated terminals 8 and 9, to which the leads to the handles 10 are attached.

The strength of the shock imparted through the handles 10 may easily be regulated by adjusting the gap between the Contact Screws. This causes the "make-and-break" to become faster or slower as the case may be, thereby varying the speed at which the primary magnetic field cuts the secondary turns.

The amusement which may be obtained from the model is almost inexhaustible and many ways of using it will occur to our readers.

Electric Semaphore Signal

As most "*M.M.*" readers are aware, power signalling is rapidly superseding manual operation on all our great railway lines. The former method is divided chiefly into the electric and pneumatic systems of operation. Electricity has been chosen as the means of operating our model, and when completed it will form a very useful addition to any miniature railway. The semaphore is pulled down by the action of a plunger, which is drawn into a solenoid coil when the current is switched on, and is returned to the "danger" position immediately the current ceases.

The general construction of the model should be quite clear from the illustration, and it is only necessary to describe the operation of the solenoid and its attendant mechanism.

The solenoid 1 is a Meccano Bobbin wound to capacity with 26 SWG insulated wire. When winding the bobbin a few inches of each end of the wire are left free so that they can be used later to connect the coil windings to the terminals 2 and 3. One of these terminals must be insulated from the Flanged Plate forming the base of the signal. The 1½″ Rod 4, termed the plunger, slides freely in the centre of the bobbin, and when the current is flowing it is drawn into the core of the solenoid. This action is explained by the well-known principle that a solenoid will draw all magnetisable objects into its core, with a force depending directly upon the number of turns of wire on the bobbin and the current flowing.

The plunger 3 is attached by an End Bearing to the freely pivoting 2½″ Strip 5, and when drawn down, it causes this Strip to move, so pushing the semaphore arm down through the medium of the connecting Rod 6. The top of this Rod 6 is attached by another End Bearing to a double-arm Crank 8 (part No. 62b) secured to the short Rod carrying the Signal Arm (part No. 158a or 158b). Immediately the current is shut off the signal returns to the "danger" position, owing to the weight of a 1″ loose Pulley and the Rod 6 acting on the longer arm of the lever 5.

The solenoid is held in position on the base Plate by two 1½″ Angle Girders 7 clamped together by 1″ Threaded Rods. The Angle Bracket 9 forms a stop to support the Strip 5 when the signal is at "danger." Care should be taken to see that the plunger is perfectly free to move in the core of the bobbin, otherwise the model will fail to work satisfactorily.

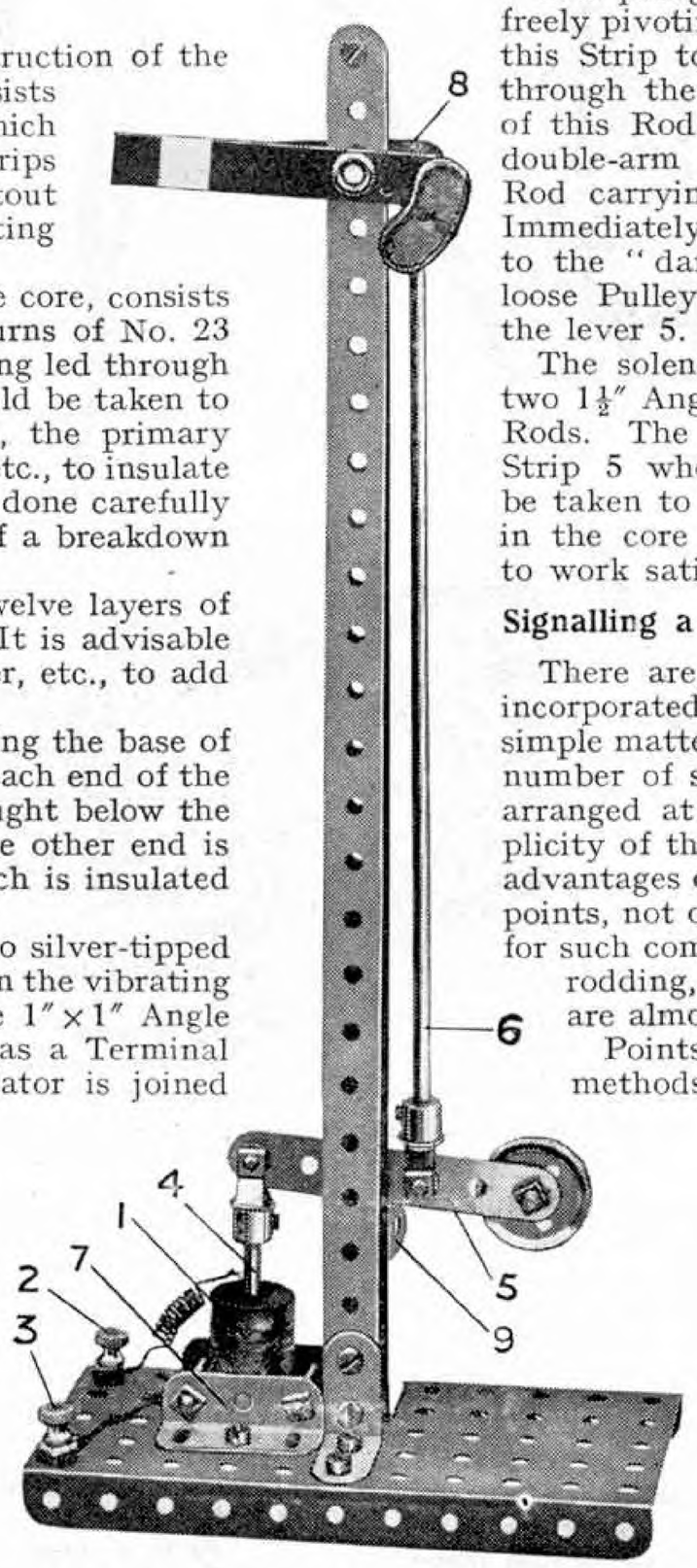


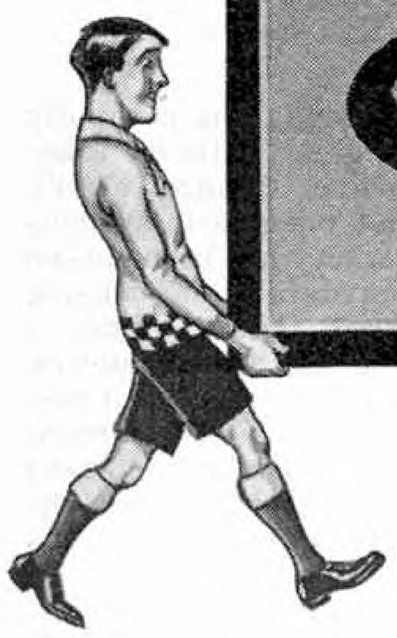
Fig. 3. Electric Semaphore Signal

Signalling a Model Railway Electrically

There are many ways in which electric signals may be incorporated in miniature railway layouts. It is quite a simple matter, for example, to equip a signal cabin with a number of switches operating an equal number of signals arranged at various points along the track. In the simplicity of the control arrangements lies one of the greatest advantages of the electrical method of operating signals and points, not only in model railways but also in real railways, for such complications as levers, wires, pulleys, bell cranks, rodding, etc., necessary in the ordinary manual methods are almost entirely eliminated.

Points can also be operated electrically, of course. The methods of operation most commonly employed in model railway layouts use either solenoids or electric motors. In the latter method the motor is connected to the points operating lever by suitable gearing and, usually, a rack and pinion movement. The solenoid method is the simplest and will no doubt appeal more readily to the majority of model railway enthusiasts for economical reasons, although both methods may be carried out entirely with Meccano parts.

Actually, two solenoids should be used, the plunger of each being connected to the tongue of the points so that the latter may be pulled one way or the other, merely by directing the current first to one solenoid and then the other.



Suggestions Section

Edited by "Spanner"



It is worth while to bear in mind that the ideas printed in the "Suggestions Section" prove a real help to thousands of Meccano enthusiasts. Often we receive letters from readers who describe how they have solved some knotty problem or evolved an interesting model after studying some of the ideas that have appeared. We shall always be pleased to receive further contributions for the "Suggestions Section." Cash payments are made for Suggestions published showing special merit. Contributions should be addressed to "Spanner," c/o The "Meccano Magazine."

(113)—Meccano Folding Camera Tripod

MANY amateur photographers who do not possess a camera tripod have at some time or another experienced the difficulty of taking time exposures when out in the open air. According to photographic text-books the mode of procedure is to "place the camera on a wall or fence, paying particular attention to the fact that the camera is in a perfectly steady position . . . ."

This is all very well, but it nearly always happens that no wall or fence of convenient height or size is available and the amateur photographer has to find some other means to support his camera steadily for the required period of time. Very often the improvised supports he uses are inadequate, and after several attempts at time exposures the amateur gives them up in favour of the "snapshot."

Although snapshots are easy to take and on the whole are fairly successful, the time exposure is vastly superior if carried out in the correct manner. Then again on dark days when the taking of a snapshot is out of the question, a time exposure can be carried out with perfect results. But in order to take successful time exposures a photographic tripod is essential. This article proves somewhat expensive if bought at a photographic shop, however, and the amateur photographer often decides to do without such a luxury altogether.

(*Continued in next column*)

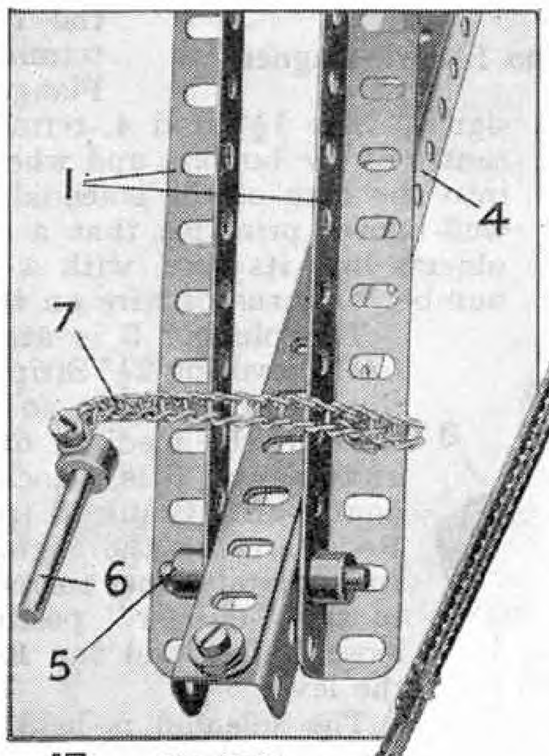
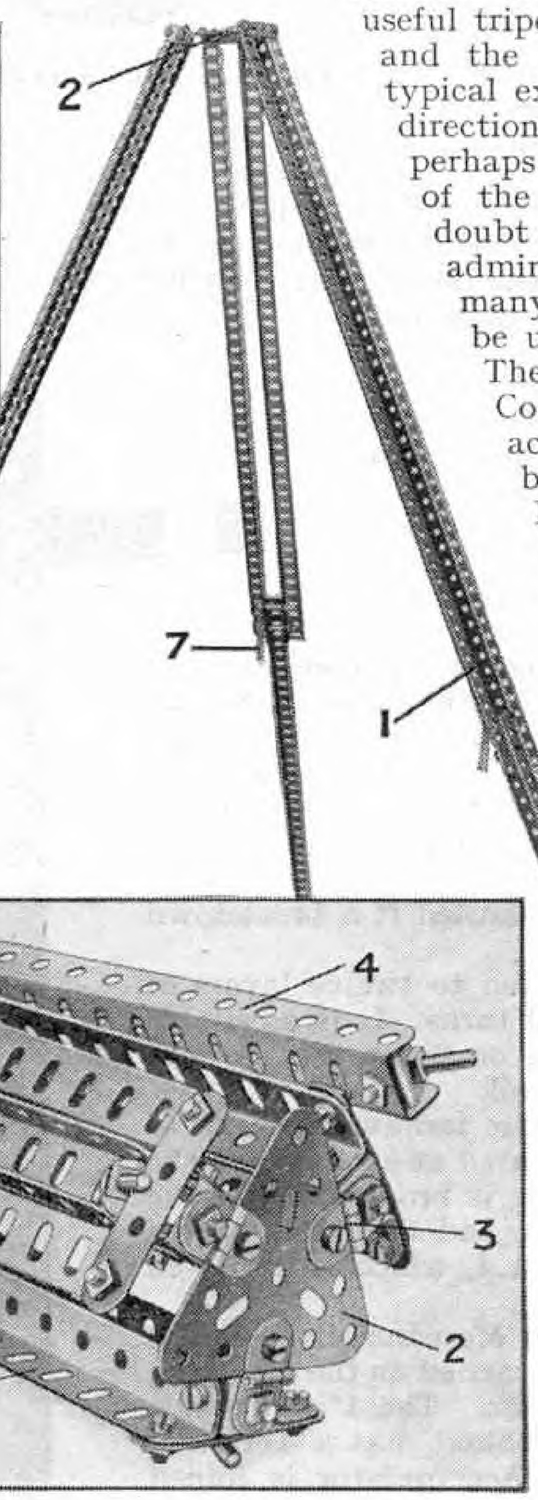


Fig. 113b



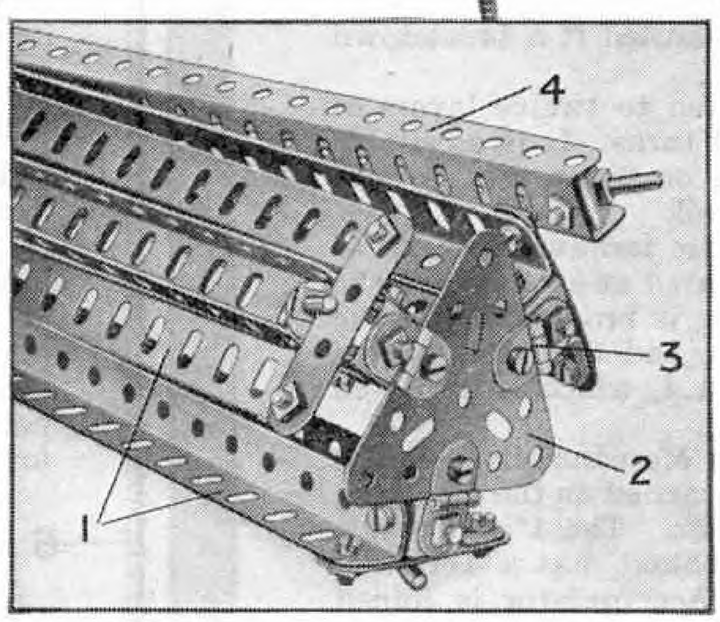


Fig. 113a

Fig. 113. The Meccano Tripod. The upper inset shows the joint in one of the legs and the lower inset is a detail view of the top of the tripod

Meccano boys have little trouble in building up useful tripods of any weight or size, of course, and the model illustrated in Fig. 113 is a typical example of what can be done in this direction. Although the tripod shown is perhaps a little heavy for the requirements of the average photographer, there is no doubt that it will serve the desired purpose admirably. It should also be useful in many respects. For example, it might be used in connection with the Meccano Theodolite (Model No. 605 in the Complete Instructions Manual), when actual surveying work could easily be carried out.

It will be seen from the illustration that 24½" Angle Girders are used throughout in the construction of the tripod, but 18½" or 12½" Girders joined end to end can be used in their place if desired.

The upper half of each of the three legs is built up from two 24½" Angle Girders 1 spaced by 2" Strips at the top end and attached to the Triangular Plate 2 by Hinges 3 (Fig. 113a). The lower portion of each leg is composed of two further 24½" Angle Girders 4 bolted rigidly together. These Angle Girders swing between the ends of the two upper Girders, the pivotal connection consisting of a 2" Rod 5. This Rod is inserted in the second hole of the upper Angle Girder and passes through the third hole from the top of the lower pair of Girders. It is held in position by means of a Collar placed on each end. The top inset illustration (Fig. 113b) shows the joint of one of the legs in detail.

A second 2" Rod 6 is provided at the joint in each leg. It is secured in a Collar that is attached by an ordinary screw to a short length of Sprocket Chain 7, and when the tripod is erect this Rod must be passed through holes in both pairs of Girders. To the bottom of each leg of the tripod is fastened an Angle Bracket with a Threaded Pin attached. After erecting the tripod, the Threaded Pins should be thrust into the ground, so as to stabilise the structure.

Parts required:

3 of No. 6	3 of No. 11	3 of No. 17	3 of No. 38	3 of No. 114
12 „ „ 7	3 „ „ 12	3 „ „ 18A	9 „ „ 59	3 „ „ 115
		24 „ „ 37	1 „ „ 76	

Miscellaneous Suggestions

(M.12). Epicyclic Gear Clutch Mechanism.—C. E. Barnes, of Stamford Hill, submits a very ingenious modification of the Meccano epicyclic gear clutch described under Suggestion No. 75 in the March, 1927, "*M.M.*" Instead of one of the clutch units being controlled by a band brake, as in the original, it is driven through suitable gearing by a second Motor, the rotative speed of which may differ to that of the primary driving Motor. With this arrangement the two Motors can be arranged to drive a model simultaneously, the epicyclic gear acting as a kind of differential to compensate for any variations in speed between the Motor armatures. With both Motors running at top speed, maximum forward speed is imparted to the driven shaft. By stopping the slower Motor a second forward speed is obtained and reversing the same Motor results in a very slow forward speed. Similarly, by reversing the main Motor a reverse drive is obtained. The operation of the device is most fascinating to watch.

(M.13). Frame for Meccano Certificate.—"A very ornamental and useful frame to hold a Meccano Guild Certificate can be constructed from two 12½" and two 9½" Braced Girders," writes Lawrence Hart, of Knotty Ash, Liverpool. A frame built on these lines would serve equally well, of course, for the Meccano Certificate of Merit.

(114)—A Useful Pen Rack

(S. T. Temple, Streatham, S.W., and K. Freeman, Coventry)

A Meccano device that may be put to really practical uses is shown in Fig. 114. It should prove invaluable not only in the home but in the office as well. Many Meccano boys, while constructing purely mechanical models such as motors, steam engines, cranes, etc., are apt to overlook the simple but practical purposes to which Meccano may be turned almost every day. These boys will be interested to know that Meccano book racks, magazine stands, pen racks, blotters, and numerous other similar devices are in everyday use in the Meccano offices at Liverpool.

The Meccano pen rack is of very neat construction and if built with enamelled parts, it will form quite an ornamental addition to any Meccano boy's "den."

The base of the rack is constructed from two 7½" Angle Girders and a 7½" Flat Girder. The latter is bolted directly to the Angle Girder 1, and is connected to the other Angle Girder 2 by a pair of Flat Brackets. These Flat Brackets are bent slightly so that the whole model can be set at an angle as indicated in the illustration.

To the fourth hole from each end of the 7½" Angle Girder 2 a Coupling is attached by means of a bolt passed through the hole and screwed tightly into the end threaded bore of the Coupling. A 4½" Rod 3 is then inserted in the other end of the Coupling, and four Cranks are mounted upon the Rod at equal distances apart. The outer ends of the Cranks should be bent slightly so that there is less likelihood of the pens or pencils rolling off.

Two further Couplings are secured to the upper ends of the Rods 3 and a 6½" Axle Rod 4 is fastened in their transverse holes. A Coupling secured to the centre of this Rod 4 carries another 4½" Rod, to the lower end of which is secured a Flanged Wheel. The angle of this Rod should be adjusted until the Flanged Wheel rests firmly on the table when the under-sides of the Angle Girders are also in contact with it.

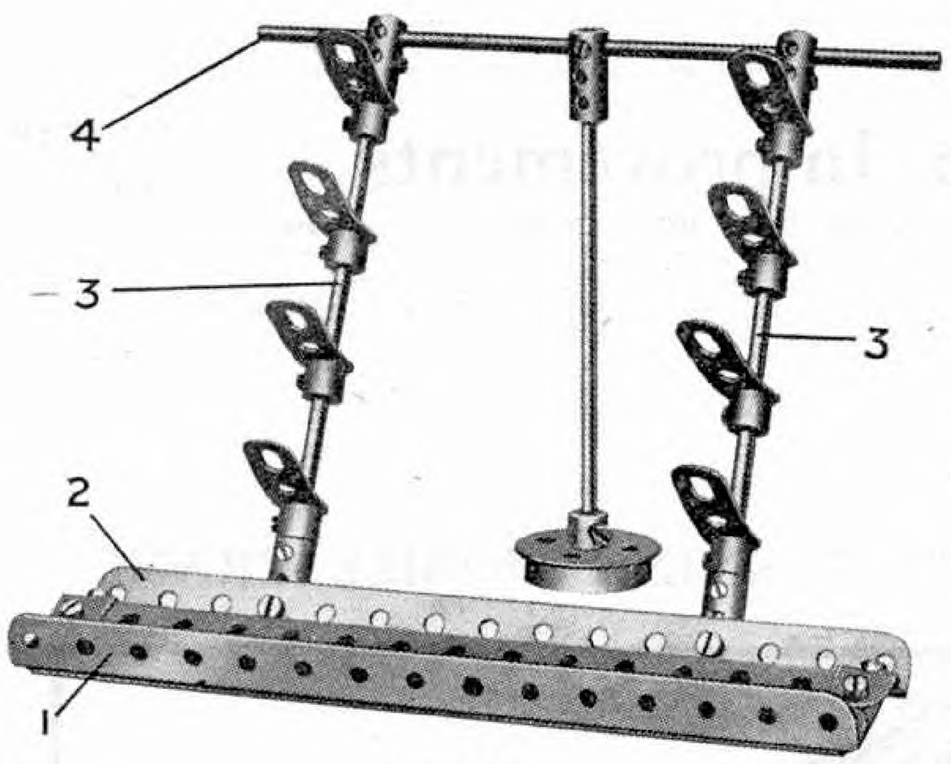


Fig. 114

(116)—Meccano Hand Punch

(W. de L. M. Messenger, Rochester)

The model shown in Fig. 116 is an extremely practical one and affords an interesting illustration of a form of parallel motion used not only in hand punches but in numerous other important mechanical devices. Although only an ordinary 1" Axle Rod is used for the punch itself, the Meccano model will easily perforate thick paper with clean-cut holes.

The punch 1 is carried in a Coupling on the end of the 5" Rod 2, and is placed so that when the handles are pressed together, its end enters the Coupling 3, which is secured to a second 5" Rod 4. The Rods 2 and 4 are free to slide in the centre transverse bores of Couplings 5 and are secured in the corresponding holes of Couplings 6.

Both pairs of Couplings 5 and 6 are mounted pivotally in the 5½" Strips, which form the operating levers of the punch, by means of ⅜" Bolts, which are passed through the Strips and secured in the ends of the Couplings. As will be seen from the illustration, a Washer is placed under the head of each bolt to obtain the proper spacing.

The Strips 4 are pivoted together by bolt and locknuts (see Standard Mechanism No. 263), and are extended by 2½" large radius Curved Strips, forming the handles. The ends of each pair of Curved Strips are connected by a Coupling.

The sliding Rod 2 carrying the punch is provided with a Collar 7 and the screw holding the latter in position is passed through the end of a tension Spring, the other end of which is attached to the 1½" Rod 8. This Spring normally holds the punch jaws in the open position. When the handles are pressed together, however, the spring is extended while the Rods 2 and 4 slide in the Couplings 5. The Rods always remain strictly parallel to each other.

It is probable that Meccano boys will find a number of interesting and important uses for this parallel movement in other Meccano models.

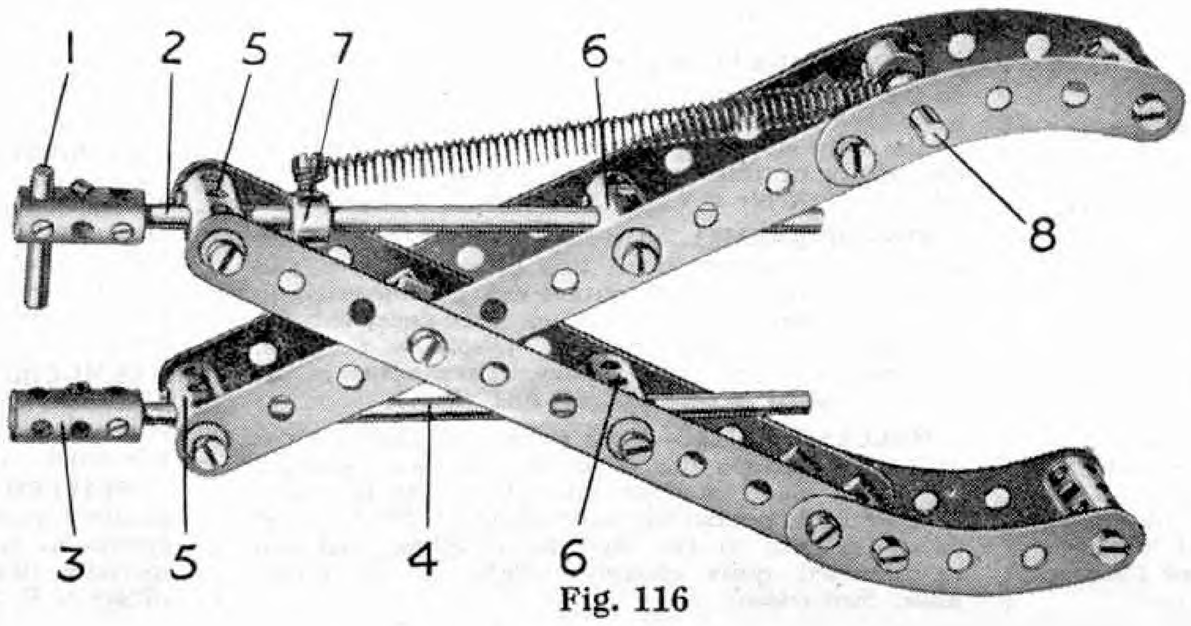


Fig. 116

(115)—Combined Match-Box Holder and Ash-Tray

(W. Kuonen, Battle, Sussex)

The combined match-holder and ash-tray illustrated in Fig. 115 is a particularly neat device that should prove popular with all members of the household. A good way by which a Meccano boy may display his ingenuity to his immediate circle of relatives and friends—and, incidentally, build up "good-will," the value of which may sometimes be realised on such occasions as birthday anniversaries, etc.!—is to construct several useful little articles of this kind and place them in different parts of the house.

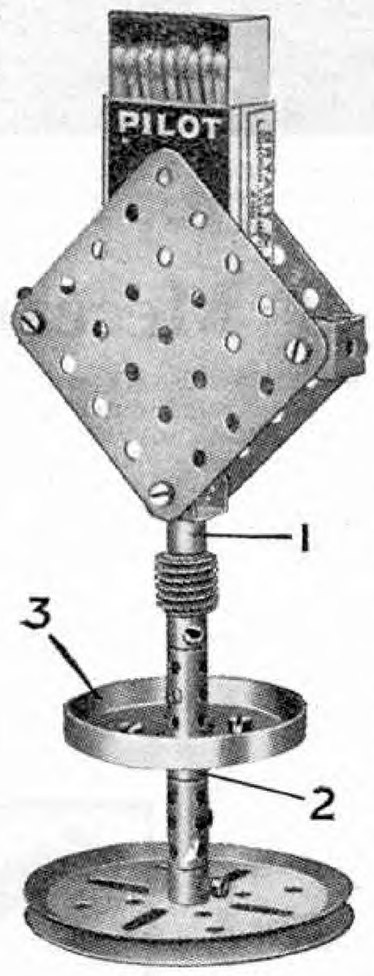


Fig. 115

The match-box holder is designed to take the standard size box of matches, and consists of two 2½" × 2½" Flat Plates joined by two Double Brackets and a Fork Piece 1. Six Washers should be placed one on each side of the Double Brackets and Fork Piece, in order to space the Plates at the correct distance apart to receive the match-box.

The stand is built up from a 3½" Axle Rod secured to a 3" Pulley Wheel forming the base. The Couplings and a Worm Wheel are fastened to the 3½" Rod to increase the weight of the stand and to add to its solid appearance, and a Bush Wheel 2 mounted in the position shown carries the Wheel Flange 3, which forms the ash-tray.

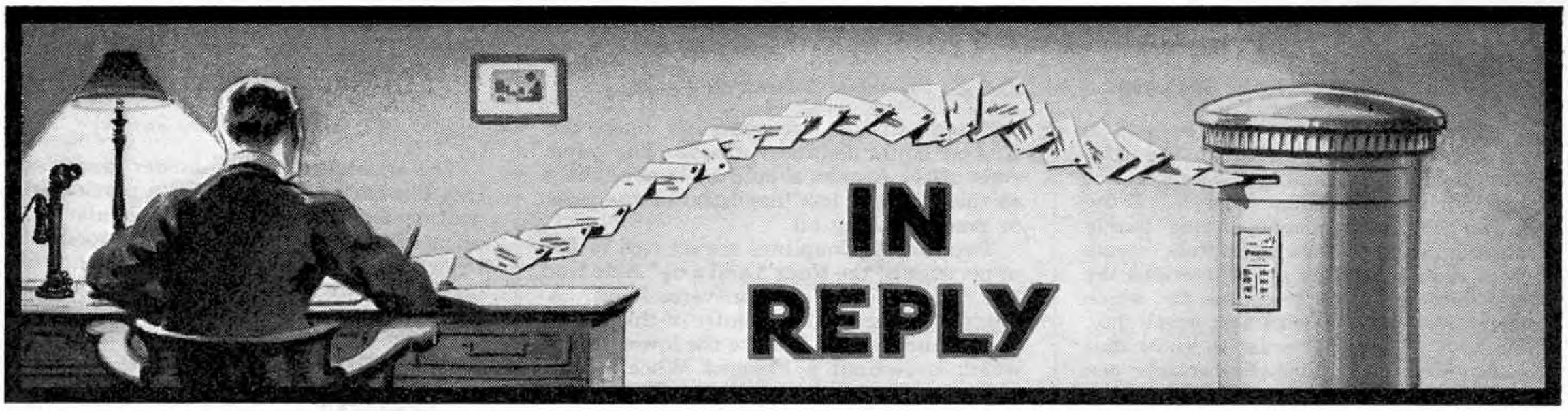
If desired a strip of sand paper or the roughened portion of a match-box cover may be pasted on each of the Flat Plates to facilitate the striking of the matches.

To complete the model a piece of felt or similar material should be gummed to the underside of the 3" Pulley Wheel, so that the stand may be placed upon polished tables, etc., without fear of scratching their surfaces.

Parts required:

2 of No. 11	1 of No. 32	2 of No. 72
1 „ „ 19B	10 „ „ 37	1 „ „ 116
1 „ „ 24	2 „ „ 63	1 „ „ 137

(M.14). Securing Wheels to Screwed Rods.—G. R. S. Agnew, of Belfast, points out that when a wheel, etc., is secured to a Screwed Rod in the usual manner, the set screw is liable to damage the thread of the Rod. He suggests that this could be avoided by placing a nut on the Rod on each side of the Wheel and screwing up tightly, thus locking the wheel in position. In securing a Threaded Boss, etc., to a Screwed Rod, only one nut is necessary.



In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Suggestions submitted for consideration in this section must be written on separate sheets of paper and the name and address of the sender must appear on each sheet used. Envelopes should be addressed to "Suggestions," Meccano Ltd., Binns Road, Liverpool.

Suggested Meccano Improvements

COMBINED BELL AND REFLECTOR.—We note your suggestion that a steel dome polished on its inner surface should be manufactured so that it could be used either as a bell or a reflector. We agree that when fitted with a Meccano lamp holder it would form a very efficient searchlight. We will give your idea careful consideration. (*Reply to J. Smith, London, N.*)

8″×3″ FLAT PLATE.—We do not consider that an 8″×3″ Flat Plate would be a suitable addition to the Meccano system as such a Plate would be liable to bend and could only be used in very few models. (*Reply to D. V. Magrass, Ferndale*).

NEW GEAR WHEEL.—We note your suggestion that a gear Wheel should be manufactured having only ¼ of its periphery occupied by teeth. Such a part is unnecessary as its functions are already covered by the Rack Segment (part No. 129). (*Reply to A. C. Coomber, Kirton*).

IMPROVED ARTILLERY WHEELS.—We were interested in your suggestion regarding the fitting of a groove in the 3″ artillery Wheels, part No. 19a. This would certainly allow 3″ rubber tyres to be fitted to them, and we will keep your idea before us. (*Reply to J. McLarin, Plymouth*).

IMPROVED RACK SEGMENT.—Your suggestion that a boss should be fitted to the rack Segment is quite interesting. It would be advisable to point out, however, that a Crank bolted to the existing Rack Segment forms a good substitute for your proposed part. (*Reply to D. Deighton, Mangaweka, New Zealand*).

CONICAL PIVOT.—We were interested in your suggestion regarding the introduction to the Meccano system of pointed rods and conical bearings. These would be useful in the construction of scientific models, etc., and we will give your idea careful consideration. (*Reply to G. and M. Cavallini, Rome*).

IMPROVED ANGLE GIRDERS.—We note your suggestion that the ends of the angle Girders should be cranked in a similar manner to the Curved Strips (part No. 89a and 90a). This is quite a good idea and we will bear it in mind. (*Reply to S. Whenm, London, S.E.*15).

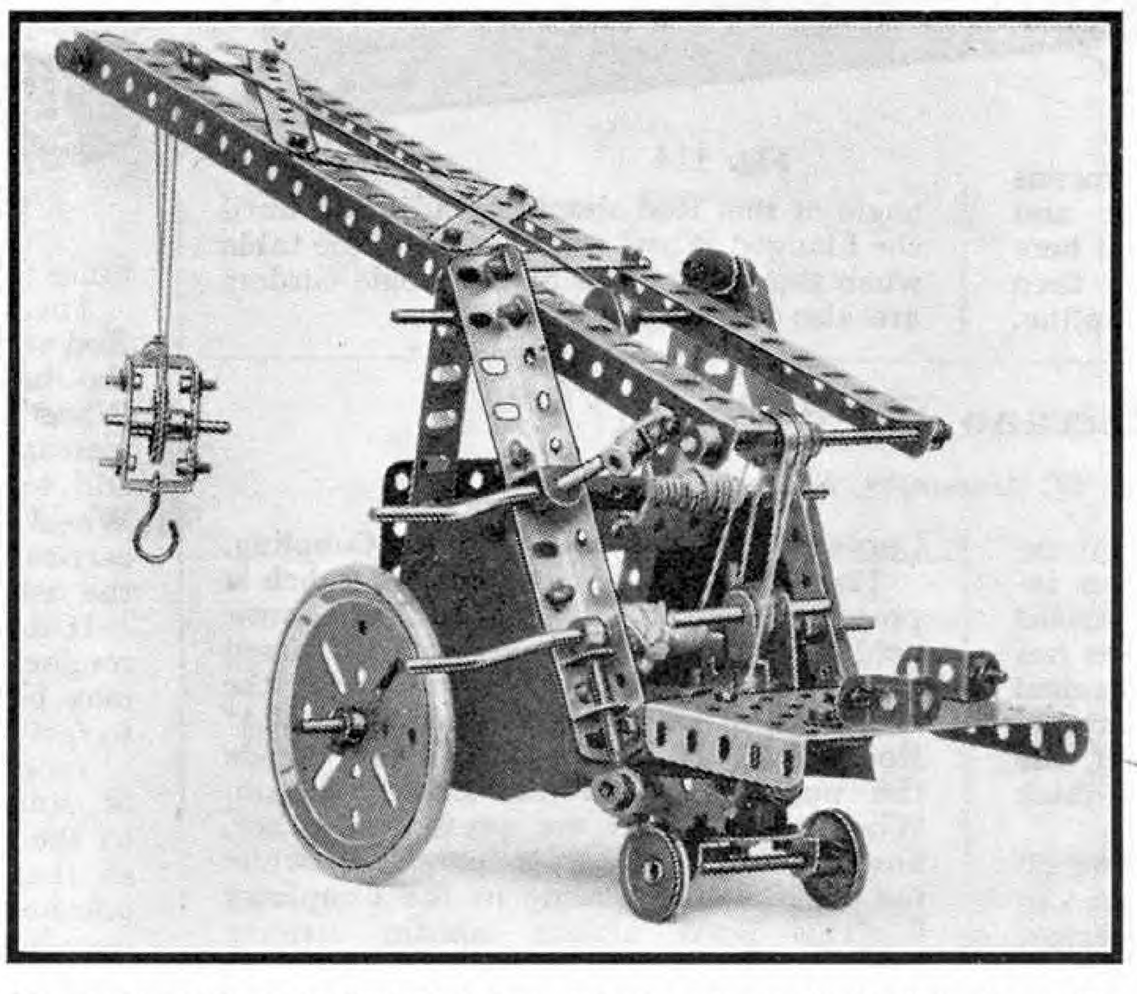
DOUBLE CRANKSHAFT.—We do not consider that a Double Crankshaft is a necessary addition to the Meccano system as where this accessary is required it can easily be built up from existing parts. (*Reply to H. V. Parking, Sultan*).

PETROL TINS.—We are afraid that your suggestion regarding the manufacture of Petrol Tins of such a size that the Meccano 8 amp. accumulator might be fitted into them is impracticable, as the acid from the accumulator would soon corrode the metal casing. (*Reply to B. Skinner, York*).

IMPROVED AXLE ROD.—We note your suggestion that all Meccano Axle Rods should be slightly flattened so that set screws may obtain a firmer grip. True running would, however, be difficult to obtain if this were done and your suggestion cannot therefore be adopted. (*Reply to W. L. Holcroft, East London, S. Africa*).

MOTOR CAR HEAD-LIGHTS.—We are afraid that Meccano motor head lamps would be of too ornamental a nature to warrant their introduction to the Meccano system. We are sure that ingenious Meccano boys will be able to construct head lamps of their own from existing parts. The Meccano bulb holder and electric bulb should prove useful in this respect. (*Reply to E. Gray, Southall*).

A PRIZE-WINNING MOBILE CRANE



The model mobile crane illustrated above gained a prize for E. H. Richards, aged 9 years, in Section B of the "November" Competition, the results of which appear on another page. As can be seen from the illustration the model is particularly well designed and constructed, and well deserves the prize allocated to it

NEW JOURNAL PIECE.—The addition of a boss to the Double Bent Strip (part No. 45) so as to give more bearing surface is, we consider, unnecessary as the Strip gives ample support by itself. Moreover, the utility of this part would be impaired by this addition. (*Reply to C. E. Bosch, Delft, Holland*).

TINS OF ENAMEL.—We hope to be able to supply in the near future, small tins of enamel (red and green) so that nickelled outfits can be converted to the New Meccano. A further announcement on this subject will appear later. (*Reply to P. Scott, Chipping Norton; J. Hedley, Birmingham; A. Godfrey Eldorel, Kenya Colony, and others*).

MECCANO DRILL.—Your suggestion that a twist drill of a suitable size to fit the Meccano coupling should be made, is quite interesting. At the same time we would remind our readers that a 5/32″ diameter twist drill will fit the Meccano Coupling, and can be obtained quite cheaply. (*Reply to D. Game, Rolle, Switzerland*).

LONGER COUPLINGS.—There does not appear to be any great demand for a longer coupling. Any alteration to the existing one would materially affect the adaptability of this part. (*Reply to Edward Jones, Buckhurst Hill*).

RIGHT ANGLE STRIPS.—Your suggestion re a right angle Strip similar to the architrave (part No. 108) but without the framework, is quite interesting. We do not see however that it offers any great advantage over part No. 108 and we cannot therefore consi ler its manufacture. (*Reply to A. W. Godder, Canterbury*).

CAST FLANGED WHEELS.—We are afraid that we cannot consider your suggestion regarding the casting of the flanged Wheels in one piece, as the change of method would result in an increase in cost. (*Reply to J. G. Munro, Aberdeen*).

1″ STRIPS.—We are afraid that little use could be found for a 1″ perforated Strip, as the flat bracket (part No. 10) can be used in every case where your suggested part is required. (*Reply to A. Feutrell, Erith, Kent*).

PETROL TANKS.—As these accessories would be purely ornamental and would serve no useful purpose their manufacture is, we fear, out of the question. (*Reply to Sydney Swanson, Burnley*).

SLOTTED STRIPS.—We agree that a Strip having a slot instead of perforations would be extremely useful in the construction of certain models. Such a Strip, however, would be very weak mechanically and for this reason could only be manufactured in short lengths. Nevertheless, we will keep your idea before us. (*Reply to J. Quich, Letchworth*).

EYE PIECE WITH BOSS.—In reply to your query we are pleased to say that the Eye Piece fitted with boss (part No. 50a) is now available. (*Reply to G. Baillie, Glasgow*).

TYRES FOR 6″ PULLEY WHEELS.—We are afraid that tyres to fit 6″ Pulley Wheels could not be introduced into the Meccano system as little use could be found for such articles. (*Reply to E. N. Nineham, Swansea*).

RUBBER WASHERS.—We do not consider that the addition of rubber washers to the Meccano system is necessary as for all general purposes the existing fibre washers are quite efficient and, unless damp, insulate perfectly. (*Reply to Colin Lomas, Sheffield, and H. V. Parkin, Sutton, Surrey*).

GROOVED RODS.—We note your suggestion regarding the cutting of a groove in Meccano Rods. As you remark an equivalent of keyed rods would be obtained by screwing the set-screws of the Pinions and gear wheels into the groove in the Rod. We are afraid however, that the diameter of the existing Meccano Rods is too small to allow such a scheme being carried out. (*Reply to P. Fortescue, Southsea*).

SEMI-CIRCULAR STRIP.—Your suggestion that we should manufacture a Semi-Circular Strip is quite interesting and we will give your idea careful consideration. (*Reply to J. Stevenson, Teddingworth*).

SMALLER FUNNELS.—We do not consider that smaller funnels are a necessary addition to the Meccano system as the Chimney Adaptor (Part No. 164) is specially designed for fitting to locomotives, etc. (*Reply to R. Stevens, Portslade-by-Sea*).

Suggested Hornby Train Improvements

NEW AND OLD STYLE SLEEPERS IN TRACK.—We are interested in your proposal that we should make a special rail comprising both the new and old type of sleeper, so that the old style of Hornby rail could be coupled to the new in a more rigid manner. We fear, however, that the demand for this accessory would not warrant the expense of manufacture. (*Reply to L. West, London, W.9, and P. Barkham, Redhill*).

DETACHABLE LAMPS ON ENGINES.—We are considering the introduction of locomotives fitted with detachable lamps, and should any decision be arrived at, it will be announced in a future issue of the "*M.M.*" (*Reply to H. C. Dyer, London, W.9*).

BRASS TRACK.—Since the inclusion of brass track fitted with wooden sleepers would only be popular amongst those Hornby enthusiasts who are fortunate enough to have a permanent layout, and who would be prepared to pay prices considerably in excess of those charged for tin plate track, we do not think it advisable to adopt your suggestion. (*Reply to G. Trowbridge, Johannesburg, S.A.*)

'RED LINE' PETROL WAGONS.—If we decide to manufacture an additional type of petrol wagon, this kind will have our consideration. (*Reply to Ronnie Majdalany, Manchester, and A. R. Morris, Dudley*).

COTTON WASTE IN FUNNELS.—Although glowing cotton waste gives out quite a considerable amount of smoke, we doubt whether this idea would be welcomed by other folk in the enthusiast's home. Apart from not giving off anything like the correct amount of smoke, it results in a most obnoxious smell. (*Reply to Eric Rothwell, Oldham*).

DETACHABLE BELL CRANKS.—We quite realise that adjustable bell cranks made to be used in conjunction with the Hornby control system, are necessary. We hope to be able to make an announcement in this respect later. (*Reply to the Rev. Canon H. Larken, Lincoln, and Donald Healy, Sheffield*).

LEVERS ON POINTS.—There is no doubt that points with levers on the inside of the curved rail would satisfy a real want. We will bear your idea in mind. (*Reply to G. E. Evans, Stoke-on-Trent*).

C.P.R. TRAINS.—As the demand for C.P.R. trains would undoubtedly be almost confined to Hornby enthusiasts in Canada, we do not think that, for the time being, at least, we can consider your suggestion. (*Reply to Frank Crompton, Esquimalt, B.C.*)

BALLAST FOR TIN PLATE TRACK.—For deadening noise and producing a realistic effect, we have no doubt that cork granules, used in the packing of grapes, give very pleasing results as you state. We would recommend other enthusiasts to try this method of ballasting. (*Reply to R. O'Donnell, Aintree, Liverpool*).

THE NEW MILK CONTAINER.—We have already been considering the possibility of introducing into the Hornby system models of the new milk container wagons. These no doubt would prove a popular addition to the series. (*Reply to P. Watts, Sidcup, Kent, and D. Mason, Ivor, Bucks.*)

0–4–2 ENGINES.—The advantages to be gained by adding a pair of trailing wheels to our No. 1 tank engines hardly prompt us to make such an alteration in their design. (*Reply to S. Webb, Ash, Surrey*).

NEW MECHANICAL TURNTABLE.—Either a hand-operated or an electrically-operated turntable would certainly prove a useful and realistic addition to Hornby railways, but we do not consider that the demands for such an accessory would justify our going any further into this matter. (*Reply to Keith Black, Winchmoor Hill, N.21, and W. A. Dodds, Ashington*).

THREE-QUARTER RAILS.—It would certainly not be worth our while to manufacture a three-quarter rail. It is perfectly easy to use a half and a quarter rail combined to produce exactly the same length of track. (*Reply to R. Loveland, Handcross, Sussex*).

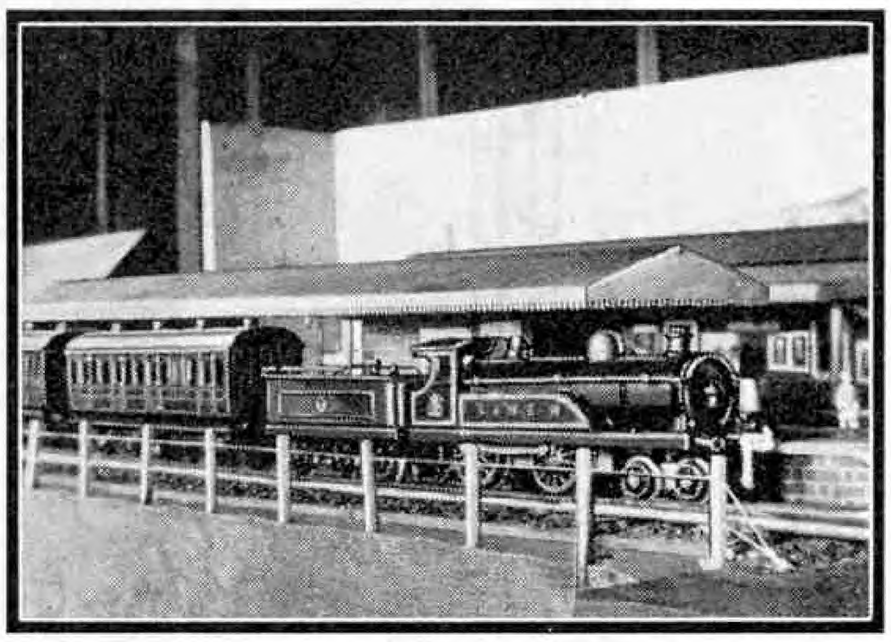
No. 1 TANK PASSENGER SETS.—If such a set is required, it can very easily be assembled by purchasing the component parts. That being so we do not consider it would be worth our while to go into this matter any further. (*Reply to E. Riley, Blackpool*).

HORSE BOXES.—As stated in these pages previously, we are considering this suggestion and experiments will shortly be carried out with miniature wagons of this description. (*Reply to W. B. Dodds, Ashington*).

SLIP COACHES.—The G.W.R. seems to be the only railway which favours the slip coach. Nevertheless we have been experimenting with a model coach so fitted with a view to introducing accessories of this kind into the Hornby System for the benefit of numerous enthusiasts who have expressed a desire to possess them. (*Reply to B. Reed, Paignton; J. Stevings, Kingsbridge, S. Devon; C. Ullem, Surbiton; G. Conway, Aberdeen; H. V. Parker, Sutton, Surrey; G. Bruce, Manchester; E. Murgatroyd, Bradford; R. Plum, Ruislip; J. Scrivener, Reading*).

OBSERVATION CARS.—An observation car is a very rare spectacle on British Railways, and we doubt very much whether this type exists in Great Britain at all. However, we are filing your idea for future consideration. (*Reply to F. Maddock, Manchester*).

'HOOKING IT' BY HORNBY



The Down 'Hook Continental' Express, drawn by Hornby 4–4–0 Loco, No. 2711

This very interesting model railway, built by Cyril Vincent, of Ipswich, represents the L.N.E.R. lines (G.E. section), between that town, Harwich (Parkeston Quay) and London (Liverpool Street). The track is laid partly in the open, and although Parkeston Quay and Ipswich are both in a shed, Liverpool Street, which is in the course of construction, will be an open-air station. The total length of the track is about 130 ft., and is all composed of standard Hornby tin plate rails, painted over with a couple of coats of brown oil colour to preserve it from the damp. As a result of this treatment the rails are wearing wonderfully well, and are not showing the slightest tendency to rust. Stations and engine sheds are all home-made. though the signal box is of Hornby manufacture. Numerous closed vans for goods, six bogie passenger coaches and a breakdown van and crane comprise the rolling stock, the last item showing that Vincent, as the manager of a miniature railway, is prepared for all eventualities.

UPPER QUADRANT SIGNALS.—Although we are aware that this type of signal will probably replace that now in existence on actual railways, many years will elapse before this happens. In the meantime, therefore, we shall continue to manufacture the lower quadrant semaphore. (*Reply to D. D. Hurger, Bethlehem, O.F.S.*)

DEEP CUTTINGS.—We like your idea of making deep cuttings, by using bent pieces of cardboard and colouring them green. A model train disappearing from view, and then re-appearing, adds very much to the realism of any model railway, in addition to which it affords an admirable excuse for making quite a handsome bridge. (*Reply to J. Baird, Noctorum, Ches.*)

LARGER RADIUS CURVES.—We have been experimenting with larger radius curves made to lead a double track through an angle of 90°, allowing the rails to remain equidistant, the inner curve being 2 ft. radius. If the results of our experiments prove favourable an announcement will be made accordingly. (*Reply to A. W. Lister, Worcester*).

SOUTHERN RAILWAY.—We hope to introduce Southern Railway colours into our system before very long. (*Reply to R. Loveland, Nr. Haywards Heath, Sussex; G. Welch, Sheffield; and others*).

NEW COAL TRUCK.—This would prove an interesting addition, but it seems to us that the Hopper wagon should satisfy all requirements for the time being. (*Reply to Alex Dunn, Sydney, N.S.W.*)

CONTROL LEVEL CROSSINGS.—We are continually enlarging the Hornby control system, and before long we hope to supply all points, crossings, etc., fitted for control work. (*Reply to G. Welch, Sheffield*).

GUN TRUCK.—Although a gun truck would be quite a novel Hornby accessory, we are afraid that it would not be in very great demand owing to its necessarily high price. (*Reply to Tom Butler, Melbourne*).

OUTSIDE CYLINDER ENGINES.—We hope to introduce this type of locomotive before long although the No. 2 tank engine will not be the first type to be so fitted. (*Reply to J. H. Leathart, Oxton, B'head, and L. M. Hicken, Accrington, Lancs.*)

4–4–0 TANK ENGINE.—We are occasionally receiving suggestions regarding 4–4–0 tank engines, and although we appreciate the fact that they would make an interesting addition to our series, the difference between them and our present No. 2 tanks would not be enough to warrant their manufacture. (*Reply to L. King, London, S.E.1*).

SHORTER COUPLINGS.—We are now experimenting with coaches fitted with new couplings with a view to shortening them to the minimum, and we will publish the results of our experiments later. (*Reply to E. Bawtree, Sutton, Surrey; R. Townsin, Peterborough; R. Mackie, Maidstone*).

SINGLE TRACK LEVEL CROSSINGS.—We quite appreciate the fact that level crossings are mostly to be found on branch lines consisting of single track, and although we only supply this kind of accessory for double track at the moment, we are giving this matter our attention and hope to make an announcement shortly. (*Reply to Francis Bean, Halstead, and Kenneth Duncan, Preston*).

MAIL TRAIN.—We agree that the introduction of a train fitted with mail exchange apparatus would be a most popular addition. (*Reply to R. Porter, Huddersfield; Aldo Toledano, Sao Paulo, Brazil; G. Hoult, Ashford, Kent; N. Weddall, Uxbridge; R. Butler, Ealing; C. Couper, Glasgow*).

FRENCH GOODS SET.—A set of this type would appeal to comparatively few. We already manufacture a Riviera 'Blue' engine and also French goods rolling stock. (*Reply to W. Gibson, Sheffield*).

HORNBY GUILD.—We should appreciate ideas and suggestions regarding the formation of a Hornby Guild, to be devoted entirely to the interests of Hornby Model Railway enthusiasts. (*Reply to S. Bruce, York*).

TEN-TON OPEN TRUCKS.—These would certainly be much more realistic if we were to include doors in the sides to open downward as in actual practice. We are giving this matter consideration. (*Reply to P. W. Cook, Lee-on-Solent, Hants.*)

RAILS WITHOUT SLEEPERS.—A variety of gauges could certainly be obtained if we were to manufacture rails that could be assembled with Meccano nuts and bolts. Apart from the great expense that would be entailed by introducing rails of this kind, however, the whole advantage of having them would be lost as all Hornby trains are for gauge 0. (*Reply to Harold Evans, Saltford, Nr. Bristol*).

GRADIENT POSTS.—We hope to be able to supply these before very long, and also various other kinds of railway notices. (*Reply to G. S. Bruce, Manchester*).

SMALLER TUNNEL.—We are afraid that there would be no demand for a smaller tunnel. The more popular suggetion is that we should enlarge the size of our present model. (*Reply to G. W. L. Telfer, Putney, S.W.15*).

SCISSORS CROSSINGS.—This kind of crossing is very complicated. It would be very costly to manufacture and therefore would necessarily have a high price. (*Reply to A. C. Lewis, Highbridge*).

MINIATURE STATION STAFF.—Sets of this kind would help to make a model railway more realistic. We are giving this matter consideration and we hope to make an announcement regarding it before very long. (*Reply to Stanley Furniss, Blackpool*).

BRAKES IN BRAKE VANS.—These would serve no useful purpose and so it would be useless to include them in our models. (*Reply to George Axe, Exeter*).

HEAVIER PETROL WAGONS.—If these prove too light and are liable to cause accidents during shunting operations, it should be quite simple to manufacture small lead weights to fix on to them out of some old water piping. (*Reply to Eric Ray, Stotfold*).

SADDLE TANK LOCOMOTIVES.—These no doubt would prove novel additions, but the difference between them and our present No. 1 tank locomotives hardly justifies the additional expense of producing them. (*Reply to Trevor Jenkins, Cardiff*).

The New Meccano Ship-Coaler

An Old Favourite in a New Form

A mechanical ship-coaling apparatus forms an ideal subject for Meccano model-building. The model described below incorporates many entirely new features and constitutes a big improvement upon earlier Meccano structures of a similar nature.

FOR a long period the coaling of steamships was carried out entirely by hand labour, and even to-day this is the case in many eastern ports. Coaling by hand cannot be otherwise than a dirty operation, causing intense discomfort to all on board. The late Sir Frederick Treves, in his interesting book "*The Other Side of the Lantern*," gives a graphic description of the miseries of coaling at Port Said. "Clouds of coal-dust envelop the poor vessel," he says, "and penetrate into every part of it. The deck becomes an ash drift. Whatever the hand finds to touch, it finds to be black. Coal-dust becomes the breath of the nostrils, coal-dust settles upon the face, powders the neck, and creeps among the hair. Moreover, in no part of the ship is there any escape from the husky din which accompanies the ritual of coaling."

On this particular occasion the coaling took place at night from great coal-carrying rafts containing gangs of hundreds of coolies. Each raft carries high aloft cressets or iron baskets blazing with fire. "The rafts are made fast to the great vessel, planks are run up to the coal bunkers, and then there begins an unceasing procession of gaunt folk carrying yellow baskets full of coal up one plank and returning with them empty along another. As they pass up and down, their rags dance in the wind, clouds of coal-dust and smoke circle round them, while the light from the cressets flashes fitfully upon the file, making their sweating limbs glow as with a fervent heat. The stream of basket carriers might be coming out from the crater of a volcano, and it is a matter of wonder that they are neither charred nor smothered . . .

"Hour after hour the dry tramp of feet along the plank continues, hour after hour the same hoarse dirge is screamed forth from a hundred creaking throats, hour after hour the spades are at work and the baskets come and go. Then the scuffle of feet ceases, the scrape of the shovels dies away, the fire in the cressets flutters out, the barges are empty, and to the same weird chant they glide away and are lost in the gloom." Such methods are picturesque but unscientific.

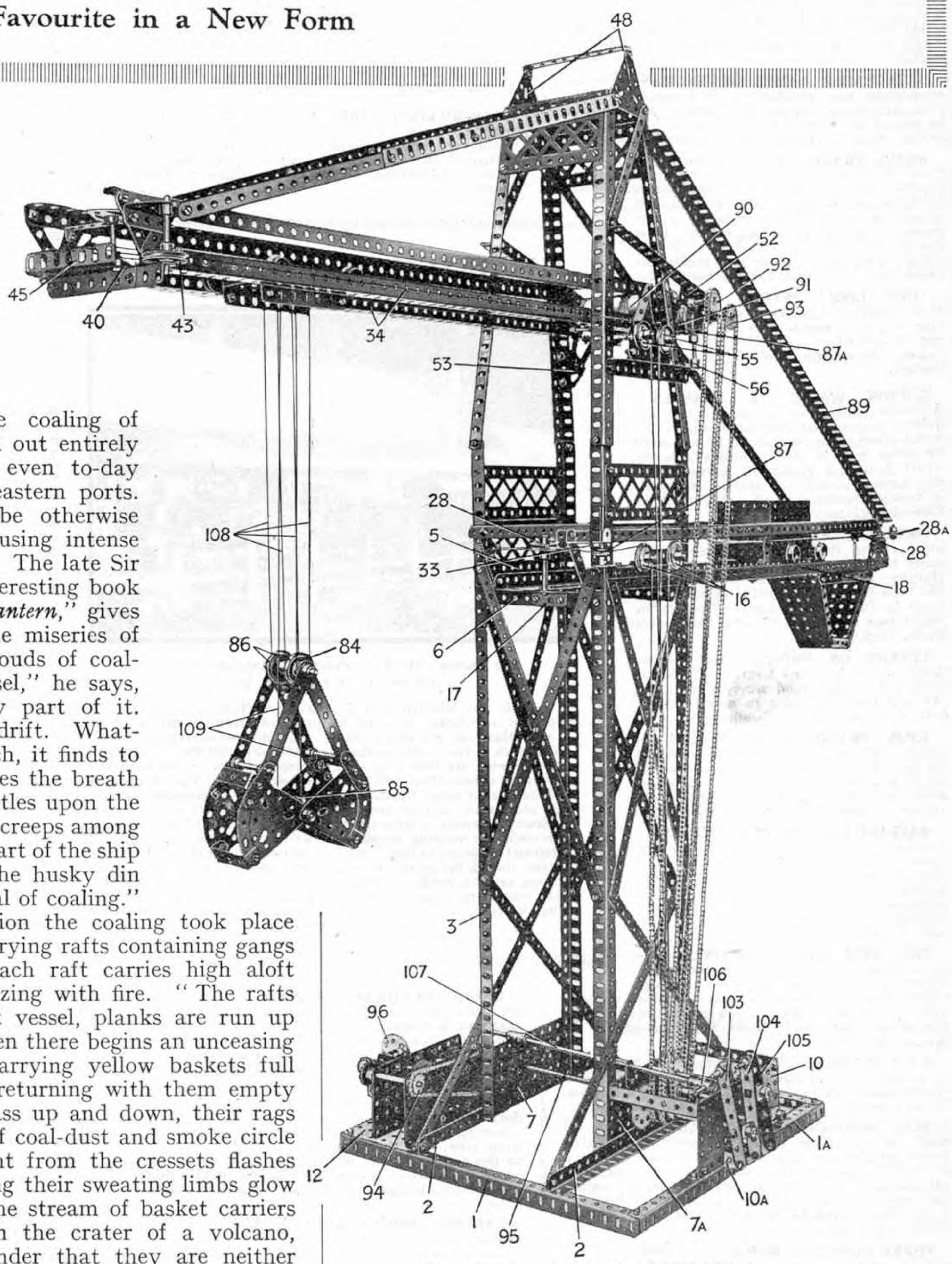


Fig. 1. General view of the Model

Coaling by Machinery

Coaling by hand on these lines is only possible in parts of the world where ample and cheap native labour is available. Elsewhere machinery must be called into play to carry out operations at a sufficient speed, and yet economically. The method employed for transferring the coal from the quayside to the ship's bunkers varies considerably in different ports, according to local

conditions and circumstances. The coaling facilities of the larger ports are naturally on a more elaborate and more interesting scale than those at the smaller ports. At Liverpool, for instance, one well-known firm has a whole fleet of floating coaling machines operated by grab in conjunction with belt conveyor, and also by bucket elevator and chutes. These machines correspond very closely in their working principles to the Meccano model about to be described.

The grab machines do not themselves carry any coal, but are moored alongside the vessel to be coaled, and barges containing the coal are brought alongside the grab machines. The grab is lowered into the barge, from which it takes up in its great steel jaws a mouthful of coal weighing something over a ton. This coal is raised to whatever height may be required and is then released on to a travelling belt conveyor, by which it is carried across the deck of the vessel to the hatchways. In the Meccano model, the automatic discharging truck corresponds to the belt conveyor.

While the coal is on its journey along the conveyor the grab descends again and takes up another load, and so the process goes on, the loading proceeding at the rate of over 100 tons per hour. As soon as one barge is emptied, another one takes its place, so that the loading continues without interruption until the necessary amount of coal has been taken on board.

The machines operated by bucket elevator and chutes differ from the grab machines in that they themselves carry the coal. They are capable of holding from 1,000 to 1,100 tons. The coal is made to fall in regulated quantities through a false bottom on to a travelling chain of buckets, which lift it to the top of the machine and discharge it down chutes directed either over the decks into hatchways, or into side ports. By means of elevator machines coaling can be carried out at the rate of some 300 tons per hour. In addition, the coal can be delivered overall to a height of more than 50 ft., thus ensuring the speedy coaling of a large liner without any necessity for the vessel to move from her loading or discharging berth.

The Meccano High-speed Ship-coaler has been designed specially to illustrate the possibilities of mechanical coaling. It is one of the most interesting of all Meccano models, and if carefully constructed it operates with wonderful precision and in a most realistic manner. The whole of the movements necessary for coaling a miniature ship are controlled from a central gear box situated in the base of the model, and are carried out with perfect accuracy. The model is one that makes a particular appeal to Meccano enthusiasts because, in addition to the enjoyment of building it, it affords endless fun when completed. Moreover, a considerable amount of dexterity is required for its successful manipulation. There are so many movements that the operator has to use his intelligence all the time, and must be quick with his fingers in order to carry out the various stages without a hitch. In other words, it is just as exciting to operate as it is to build—an ideal model for all really enthusiastic Meccano Boys. It is particularly suited for use in loading Hornby Wagons from a miniature coal-dump.

The Main Tower

The construction of the model should be commenced by building the main tower. Fig. 2 shows the tower in detail, with superstructure, gearing, etc., removed. The base of the tower consists of four $12\frac{1}{2}''$ Angle Girders 1 bolted in the form of a square and spanned by two similar Girders 2. Four $24\frac{1}{2}''$ Angle Girders 3, forming the chief supports of the tower, are braced at the top by the $5\frac{1}{2}''$ Angle Girders 6, 6a and the $5\frac{1}{2}''$ Braced Girders 4, 5, whilst their lower ends are joined by two $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates 7, 7a. The rigidity of the structure is increased by crossed $12\frac{1}{2}''$ Strips 8, 9.

The framework of the gear box is formed by erecting a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate 10 edgewise on one of the base Girders

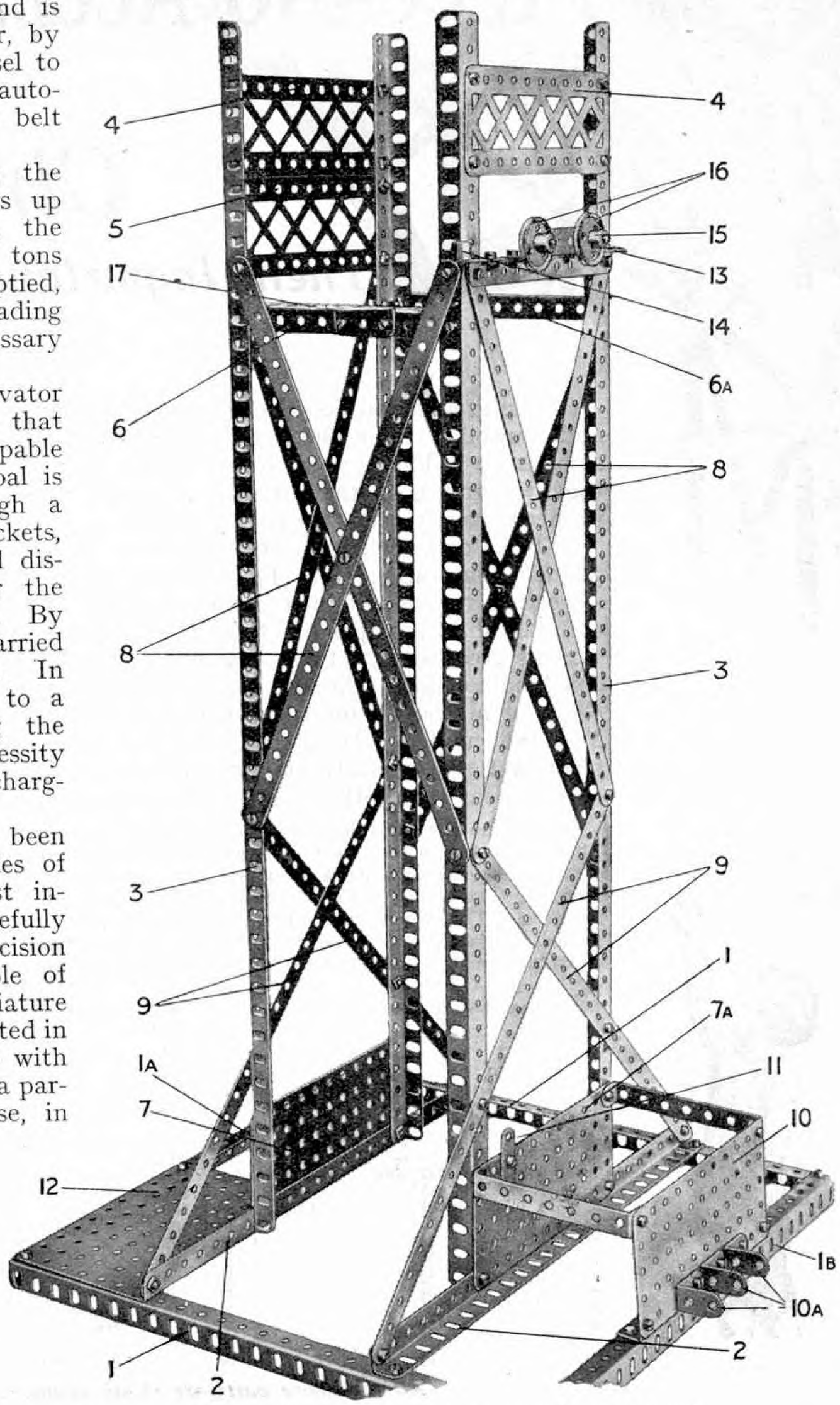


Fig. 2. Detail view of Main Tower



MECCANO ACCESSORY PARTS

Girders

Their Importance in Engineering

The greatest works of engineering depend for their strength and durability upon the massive girders of steel which, though sometimes hidden by an outer casing of masonry, bind them together and hold them rigid. A single rolled steel girder, if properly constructed, proves as strong as a wall of masonry.

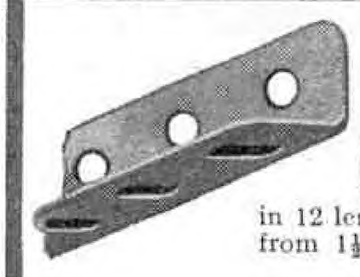
The Forth Bridge, a steel highway 1½ miles in length, suspended high above the Forth; the Eiffel Tower, extending almost to the height of a mountain; the Woolworth Building, the tallest skyscraper in New York—these are three of the world's greatest structures that stand like monuments to man's constructive skill. The last named disguises its steel skeleton in a cloak of masonry, but the others tower into the sky like huge Meccano models. It is plain to see how even the smallest strut or tie is carefully planned and placed into position so that it may bear its allotted portion of strain or thrust.

Meccano Girders fulfil the same important duty in Meccano engineering. They are fitted into models and braced by Strips or Rods until the finished structure would support a man's weight, without the slightest disruption. Meccano Girders are made of the finest steel, and are beautifully enamelled in green. The edges and corners are rounded and smoothed off, while the perfect accuracy of their manufacture makes them invaluable in the construction of even the most intricate mechanisms.



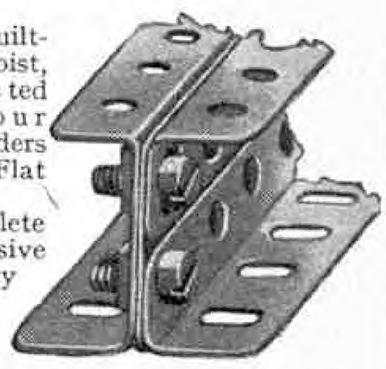
No.			s.	d.
1.	Perforated Strips, 12½" long	½ doz.	1	0
1a.	" " 9½" "	"	0	9
1b.	" " 7½" "	"	0	8
2.	" " 5½" "	"	0	6
2a.	" " 4½" "	"	0	5
3.	" " 3½" "	"	0	4
4.	" " 3" "	"	0	3
5.	" " 2½" "	"	0	3
6.	" " 2" "	"	0	3
6a.	" " 1½" "	"	0	3
7.	Angle Girders, 24½" long	each	0	8
7a.	" " 18½" "	"	0	6
8.	" " 12½" "	½ doz.	1	9
8a.	" " 9½" "	"	1	3
8b.	" " 7½" "	"	1	2
9.	" " 5½" "	"	1	0
9a.	" " 4½" "	"	0	10
9b.	" " 3½" "	"	0	8
9c.	" " 3" "	"	0	8
9d.	" " 2½" "	"	0	7
9e.	" " 2" "	"	0	6
9f.	" " 1½" "	"	0	6

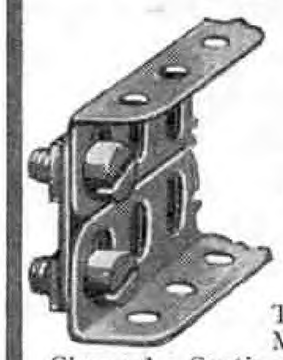
No.			s.	d.
97.	Braced Girders, 3½" long	½ doz.	0	9
97a.	" " 3" "	"	0	8
98.	" " 2½" "	"	0	6
99.	" " 12½" "	"	1	9
99a.	" " 9½" "	"	1	6
99b.	" " 7½" "	"	1	3
100.	" " 5½" "	"	1	0
100a.	" " 4½" "	"	0	10
103.	Flat Girders, 5½" long	"	1	0
103a.	" " 9½" "	"	1	6
103b.	" " 12½" "	"	2	0
103c.	" " 4½" "	"	0	9
103d.	" " 3½" "	"	0	7
103e.	" " 3" "	"	0	6
103f.	" " 2½" "	"	0	5
103g.	" " 2" "	"	0	4
103h.	" " 1½" "	"	0	3
103k.	" " 7½" "	"	1	3
113.	Girder Frames (triangulated truss type)	each	0	2
143.	Circular Girders, 5½" diam. "L" section	"	1	0

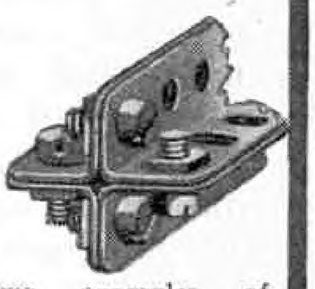


Angle Girders ("L" section, ½" × ⅝") in 12 lengths, ranging from 1½" to 24½".

Meccano built-up Steel Joist, constructed from four Angle Girders and one Flat Girder. The complete unit is massive and of very great strength.

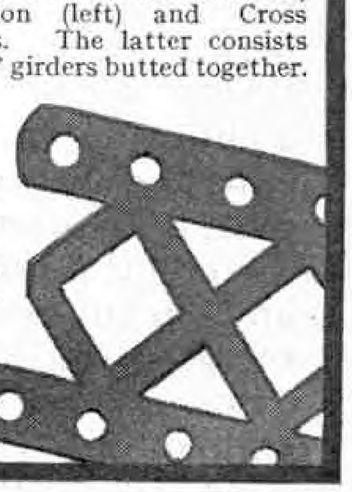






Two examples of Meccano construction; Channel Section (left) and Cross Section Girders. The latter consists of a pair of "T" girders butted together.

Braced Girders. Stout lattice-work throughout. Width 2". In 5 lengths, 2½" to 12½". Very ornamental and of great utility.



All the above parts are richly enamelled in colours.

YOUR DEALER WILL BE PLEASED TO SHOW YOU ALL THE MECCANO PARTS. ASK HIM FOR A COMPLETE PRICE LIST.

MECCANO LTD., BINNS ROAD, LIVERPOOL

1 and joining it to the Plate 7a by means of two $3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips. Three $1'' \times 1''$ Angle Brackets 10a are secured to the outer side of the Plate 10, and a $1\frac{1}{2}''$ Strip 11 is attached in a vertical position to the Plate 7a. A $5\frac{1}{2}'' \times 3\frac{1}{2}''$ Flat Plate 12, bolted to the base in the position shown, forms the bed to which an Electric Motor will later be attached.

A $5\frac{1}{2}''$ Angle Girder 13 bolted near the upper ends of two of the Girders 3, above the gear box, carries a Crank 14, and a 2" Angle Girder 15 secured to the Girder 13 carries two 1" loose Pulley Wheels 16, which are mounted on Threaded Pins and kept in position by Collars and set-screws. The addition of a Trunnion 17 to the Girder 6 completes the construction of the main tower unit. Care should be taken that all parts are situated correctly, as each will have a definite use in the completed model.

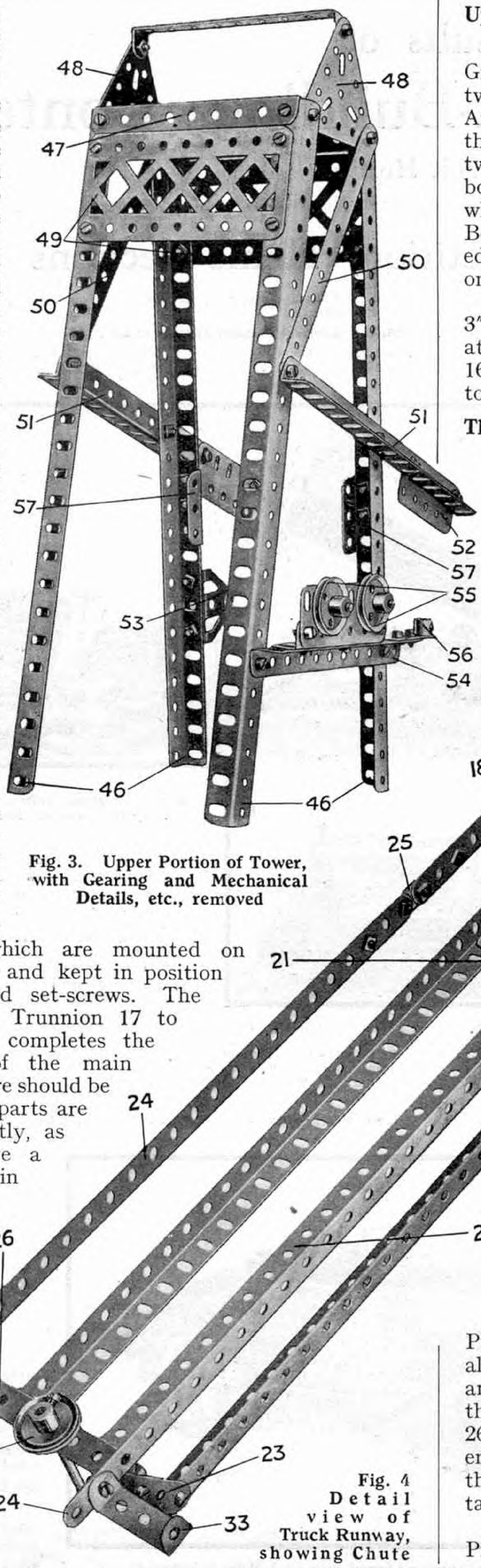


Fig. 3. Upper Portion of Tower, with Gearing and Mechanical Details, etc., removed

Upper Portion of Tower

The upper tower (Fig. 3) is built of four $12\frac{1}{2}''$ Angle Girders 46 surmounted by two $4\frac{1}{2}''$ Angle Girders 47 and two $2\frac{1}{2}''$ Triangular Plates 48 joined by a $4\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip. The wider sides of the tower are strengthened by $4\frac{1}{2}''$ Braced Girders 49, and the narrow sides by two $5\frac{1}{2}''$ Strips 50. To the ends of these Strips 50 are bolted the $7\frac{1}{2}''$ Angle Girders 51, the projecting ends of which slope downward and carry $2\frac{1}{2}''$ Flat Girders 52. Below the Girders 51, two $1\frac{1}{2}''$ Angle Girders 57 are attached to the upright 46 as shown, and further down, on one side only, is a Trunnion 53.

The $5\frac{1}{2}''$ Angle Girder 54 carries a 3" Angle Girder and a 3" Flat Girder, to which the 1" loose Pulleys 55 are attached by Threaded Pins in the same way as the Pulleys 16 (Fig. 2). A Crank 56 is bolted as shown (Fig. 3) to the short projecting end of the Girder 54.

The Truck Runway

The construction of the truck runway, together with the chute from which the coal is finally discharged into the hold of the ship,

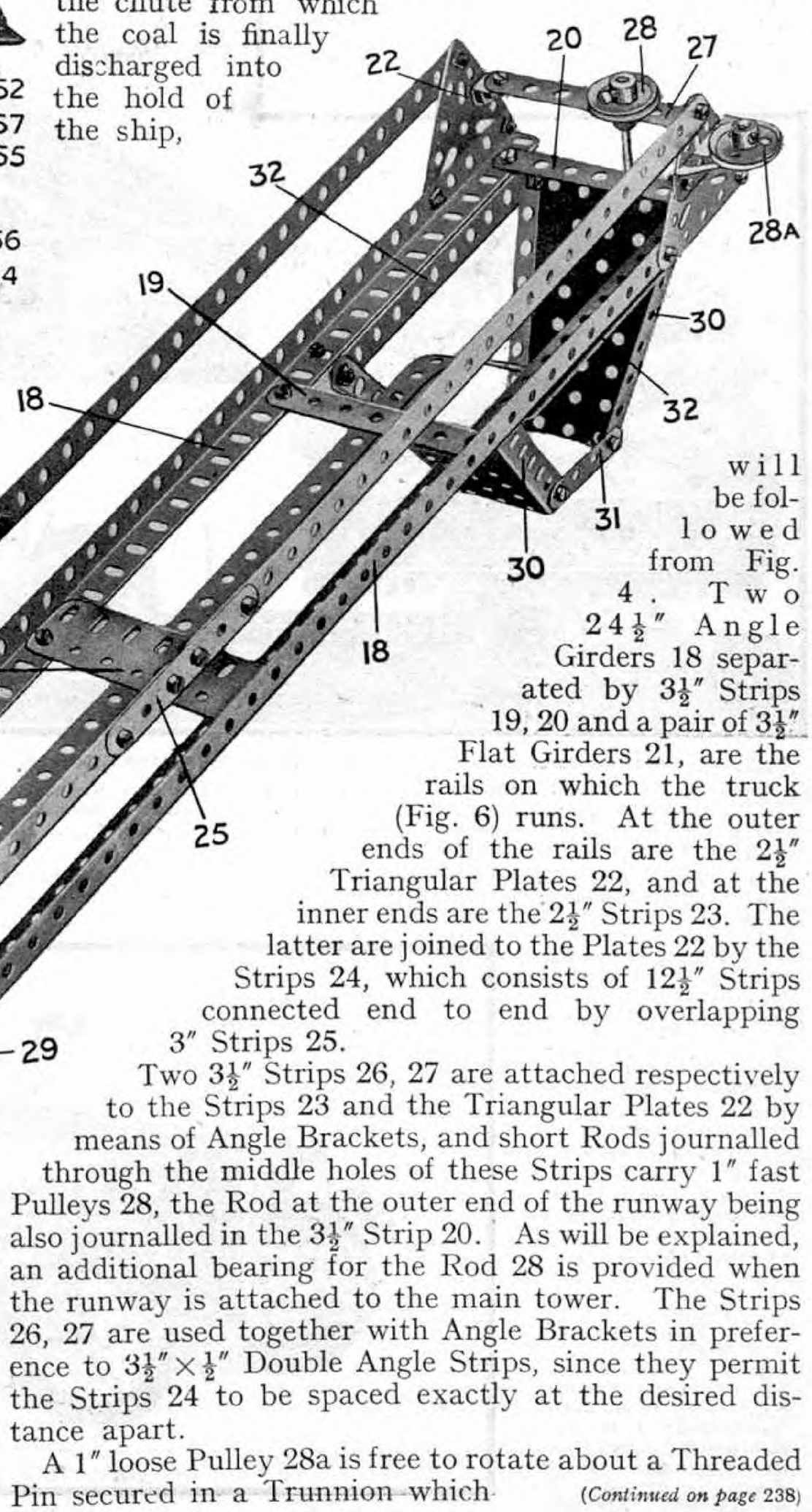


Fig. 4 Detail view of Truck Runway, showing Chute

will be followed from Fig. 4. Two $24\frac{1}{2}''$ Angle Girders 18 separated by $3\frac{1}{2}''$ Strips 19, 20 and a pair of $3\frac{1}{2}''$ Flat Girders 21, are the rails on which the truck (Fig. 6) runs. At the outer ends of the rails are the $2\frac{1}{2}''$ Triangular Plates 22, and at the inner ends are the $2\frac{1}{2}''$ Strips 23. The latter are joined to the Plates 22 by the Strips 24, which consists of $12\frac{1}{2}''$ Strips connected end to end by overlapping 3" Strips 25.

Two $3\frac{1}{2}''$ Strips 26, 27 are attached respectively to the Strips 23 and the Triangular Plates 22 by means of Angle Brackets, and short Rods journalled through the middle holes of these Strips carry 1" fast Pulleys 28, the Rod at the outer end of the runway being also journalled in the $3\frac{1}{2}''$ Strip 20. As will be explained, an additional bearing for the Rod 28 is provided when the runway is attached to the main tower. The Strips 26, 27 are used together with Angle Brackets in preference to $3\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips, since they permit the Strips 24 to be spaced exactly at the desired distance apart.

A 1" loose Pulley 28a is free to rotate about a Threaded Pin secured in a Trunnion which (*Continued on page* 238)

Results of Meccano Model-Building Contests

By Frank Hornby

"November" Competition, Home Sections

A GLANCE at the photographs reproduced on this and the accompanying page will show at once that the entries in the "November" competition reached a very high standard. Moreover, the number of entries creates a fresh record, for the total exceeds by far that of any previous contest. The following is a list of the prize-winners in the Home Sections :—

Section A (Competitors over 14 years of age).

FIRST PRIZE (Cheque to the value of £3-3s.): Eric Campbell, Castledermot, Co. Kildare. SECOND PRIZE (Tie; each competitor will receive a cheque to the value of £2-2s.): J. Wilks, Station Road, Ashford, Kent, and A. Thomas Locke, Shottery, Stratford-on-Avon. THIRD PRIZE (Cheque to the value of £1-1s.): H. T. Bates, Hayes Street, West Bromwich.

SIX PRIZES, each of Meccano products to the value of 10/6: J. C. Pearse, Kingston-on-Thames; W. R. Hastings, Gravelly Hill, Birmingham; R. Mitchell, Keighley, Yorks.; G. N. Keightley, Ipswich; Stanley Brockett, London, S.E.11; C. H. Harrison, Blackpool.

TWELVE PRIZES, each of Meccano products to the value of 5/-: R. Kirkham, Elworth, near Sandbach; E. Ray, Stotfold, Herts.; C. Johnson, Tunbridge Wells; L. Hollyoak, Coventry; C. Randolph Weller, Moseley, Birmingham; R. Coombes, Witney, Oxon; T. A. C. Moorhouse, North Acton, London, W.3; A. C. Rogers, Hawkhurst, Kent; F. Lord, Bacup, Lancs.; P. Woodman, Exeter; C. Hulme, Marple; A. T. Wilkinson, Abercarn.

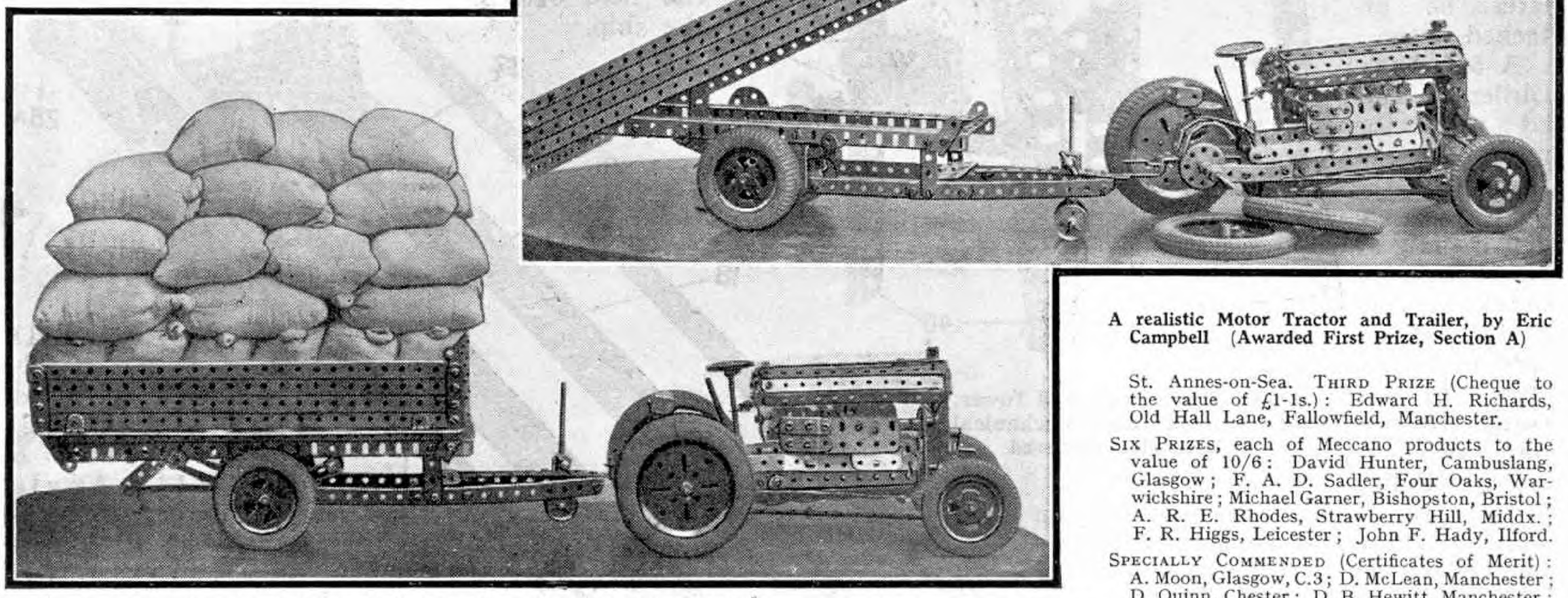
SPECIALLY COMMENDED (Certificate of Merit): Hector Telford, Lower Largo, Fife; S. Budge, St. Sampsons, Guernsey; L. Doughty, Croydon; W. V. Whitbread, London, N.W.10; G. Harcourt, Evesham; W. Purnell, Andover; R. H. Mann, Mytholmroyd, Yorks.; J. Redfern, Salford; W. Green, Burnley; E. Bates, London, S.E.17; F. Bosomworth, Macclesfield; J. B. Holt, Manchester; Alfred Brunner, Upminster; D. P. Plummer, Guernsey; H. A. Davies, Abergele; K. Lister Kilner, Huddersfield; William Great-Rex, Liverpool; Jack Wardle, Burton-on-Trent; P. Lyth, Newcastle.

Section B (Competitors under 14 years of age).

FIRST PRIZE (Cheque to the value of £3-3s.): Alan B. Horn, Thirlmere Road, London, N.10. SECOND PRIZE (Cheque to the value of £2-2s.): Alan Hill, Clarendon Road, St. Annes-on-Sea. THIRD PRIZE (Cheque to the value of £1-1s.): Edward H. Richards, Old Hall Lane, Fallowfield, Manchester.

SIX PRIZES, each of Meccano products to the value of 10/6: David Hunter, Cambuslang, Glasgow; F. A. D. Sadler, Four Oaks, Warwickshire; Michael Garner, Bishopston, Bristol; A. R. E. Rhodes, Strawberry Hill, Middx.; F. R. Higgs, Leicester; John F. Hady, Ilford.

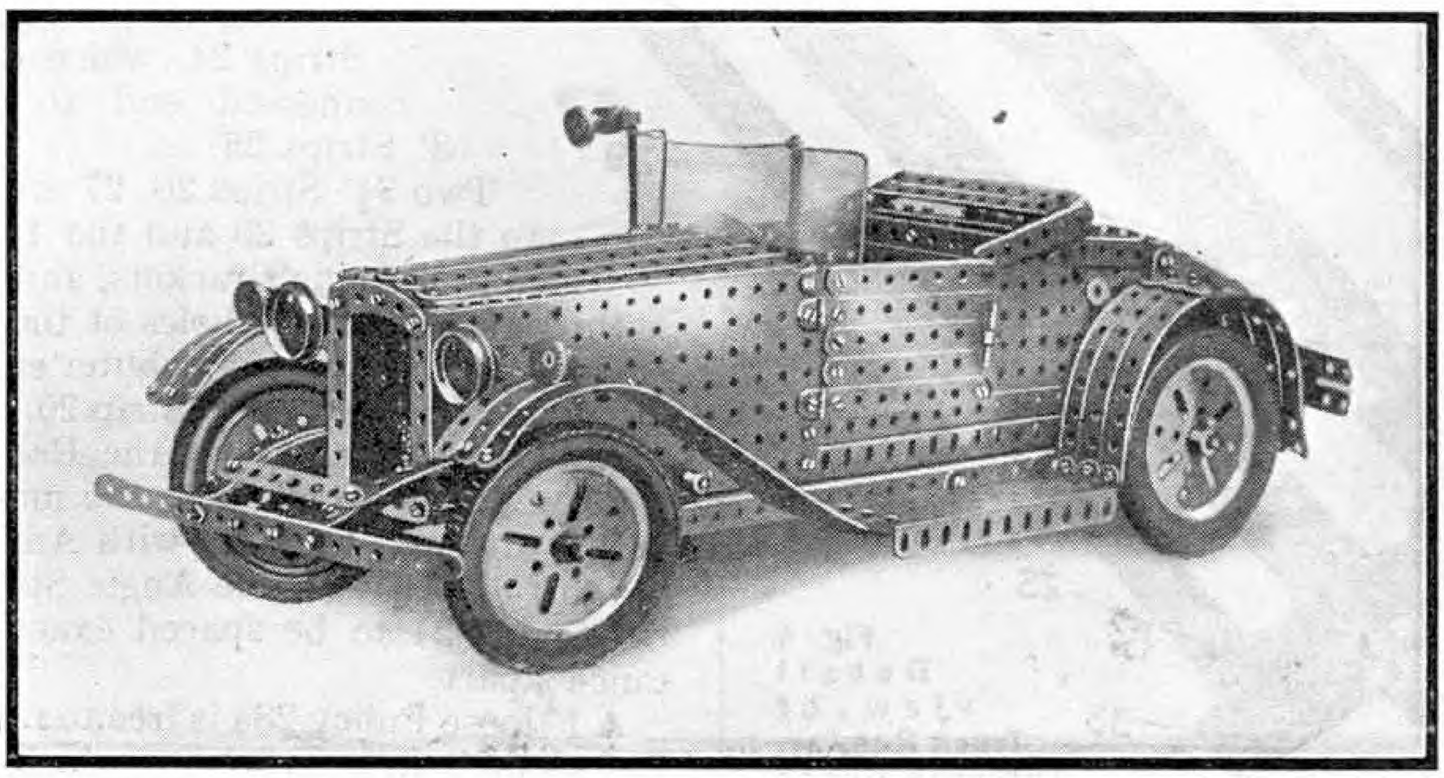
SPECIALLY COMMENDED (Certificates of Merit): A. Moon, Glasgow, C.3; D. McLean, Manchester; D. Quinn, Chester; D. B. Hewitt, Manchester; Ronald S. Comfort, Bury, Lancs.; Arthur Wendt, Barry Dock, S. Wales; B. Hartley, Earby; J. Burdon, Whitby; H. Holden, Chatburn, near Clitheroe; Rex J. Booker, Rustington; R. Viney, Manchester; C. Busby, Sharpenhoe, near Ampthill; Neil Monie, Leigh-on-Sea; L. D. Carter, Corsham, Wilts.; Bernard E. Whitby, Waltham Cross, Herts.; A. E. Matthews, Teddington, Middx.



A realistic Motor Tractor and Trailer, by Eric Campbell (Awarded First Prize, Section A)

The First Prize-winner in Section A, Eric Campbell, submitted a model of a "Fordson" tractor and trailer, two views of which are shown on this page. It is an exceedingly well-made model, and the tractor itself has a very realistic appearance. The engine in the tractor is cleverly represented by Flat Girders, etc., and a radiator fan is fitted at the front. The rear road wheels are duplicated, as can be seen in the upper illustration, in order to obtain a firmer grip on the road.

The trailer is fitted with springs of the semi-elliptic type, and the sides and back

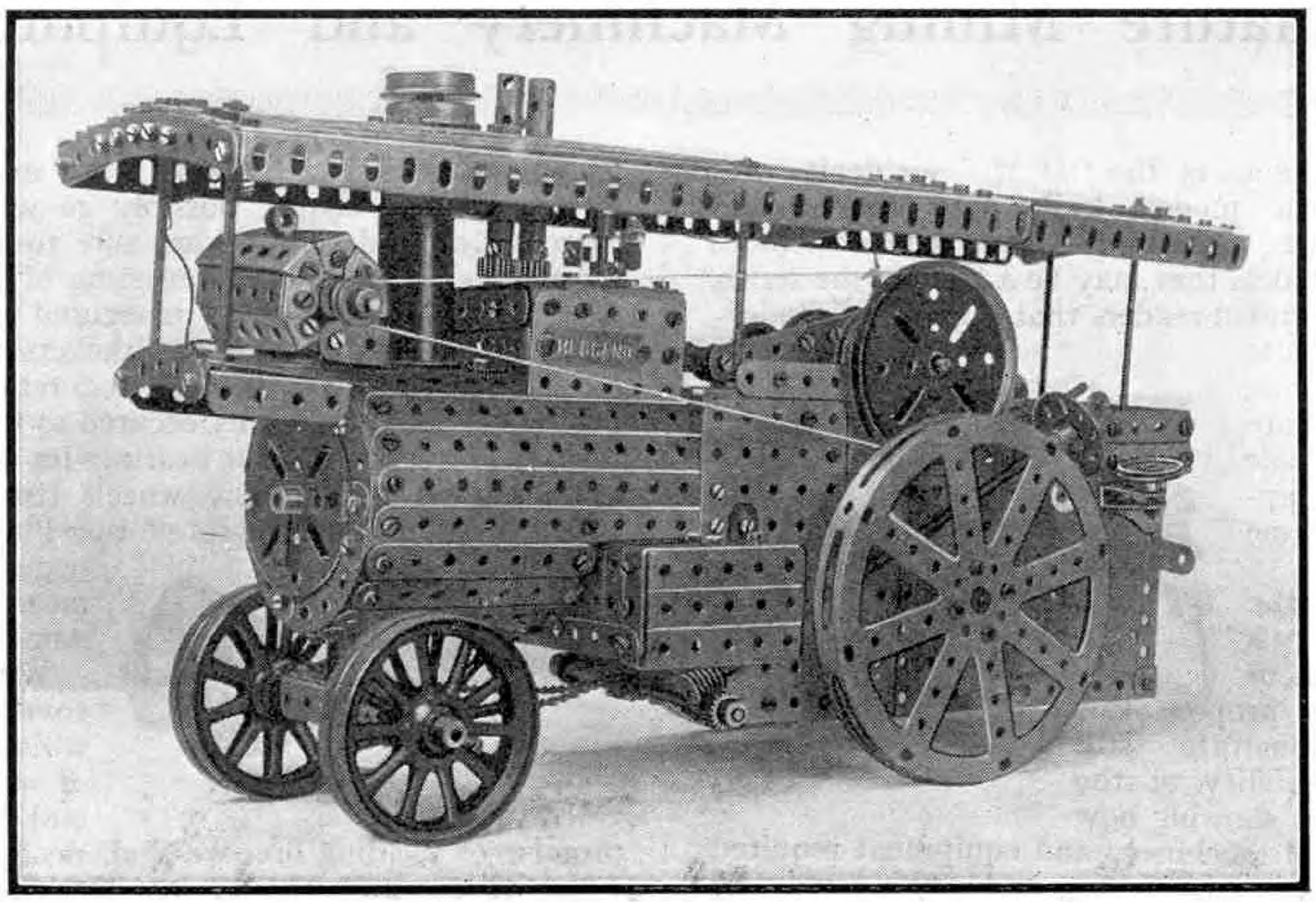


This well proportioned two-seater Motor Car secured Second Prize for J. Wilks in Section A

of the body are hinged and can be let down at will. An ingenious method is adopted for tipping the body ; this consists of a Rack Strip pivoted beneath the floor and engaging with a Pinion fastened to a Rod journalled in the chassis of the trailer. By rotating a hand wheel secured to this Rod the body is raised or lowered.

J. Wilks, who tied with A. T. Locke for the Second Prize, sent in the realistic model two-seater car shown in another illustration. Readers who are interested in motoring matters will note that the lines of the model closely resemble those of the famous "Morris" two-seater. A "dickey" seat is provided, together with front and rear bumpers, and a spot light is fitted to the windscreen framework. The front mudguards, which are equipped with small lamps consisting of ¾" Contrate Wheels, are neatly made and give the bodywork quite a "speedy" appearance.

Equally interesting is Arthur Locke's traction engine, also illustrated. This is a faithful reproduction of the type of steam tractor used for heavy road haulage work. To obtain more bearing surface the front wheels, which consist of Meccano Flywheels, are duplicated. Steering is effected by means of chains attached to each end of the front axle, and actuated from the steering wheel through Worm and Pinion mechanism. The disposition of the flywheel, driving wheels, and chimney gives the model a most realistic appearance. The tractor is driven by means of a Clockwork Motor, the reversing lever of which can be seen protruding from the rear of the model.



A. T. Locke's splendid Meccano Traction Engine (Second Prize, Section A)

An enterprising competitor, H. T. Bates, sent in a large number of models, all of which are constructed on new and original lines. Amongst these the most outstanding are a vertical engine fitted with balanced crank shaft, a concrete-mixer, and a railway breakdown crane.

C. H. Harrison who, along with five other competitors, receives a prize to the value of half a guinea, sent in a model of the 200-ton floating crane which was described in the March, 1927, issue of the "*M.M.*" and is now in use at Le Havre. Harrison's model is a very good effort, the general appearance of the actual crane being reproduced very accurately. The various movements, such as luffing the jib, hoisting, and slewing, are controlled by an Electric Motor.

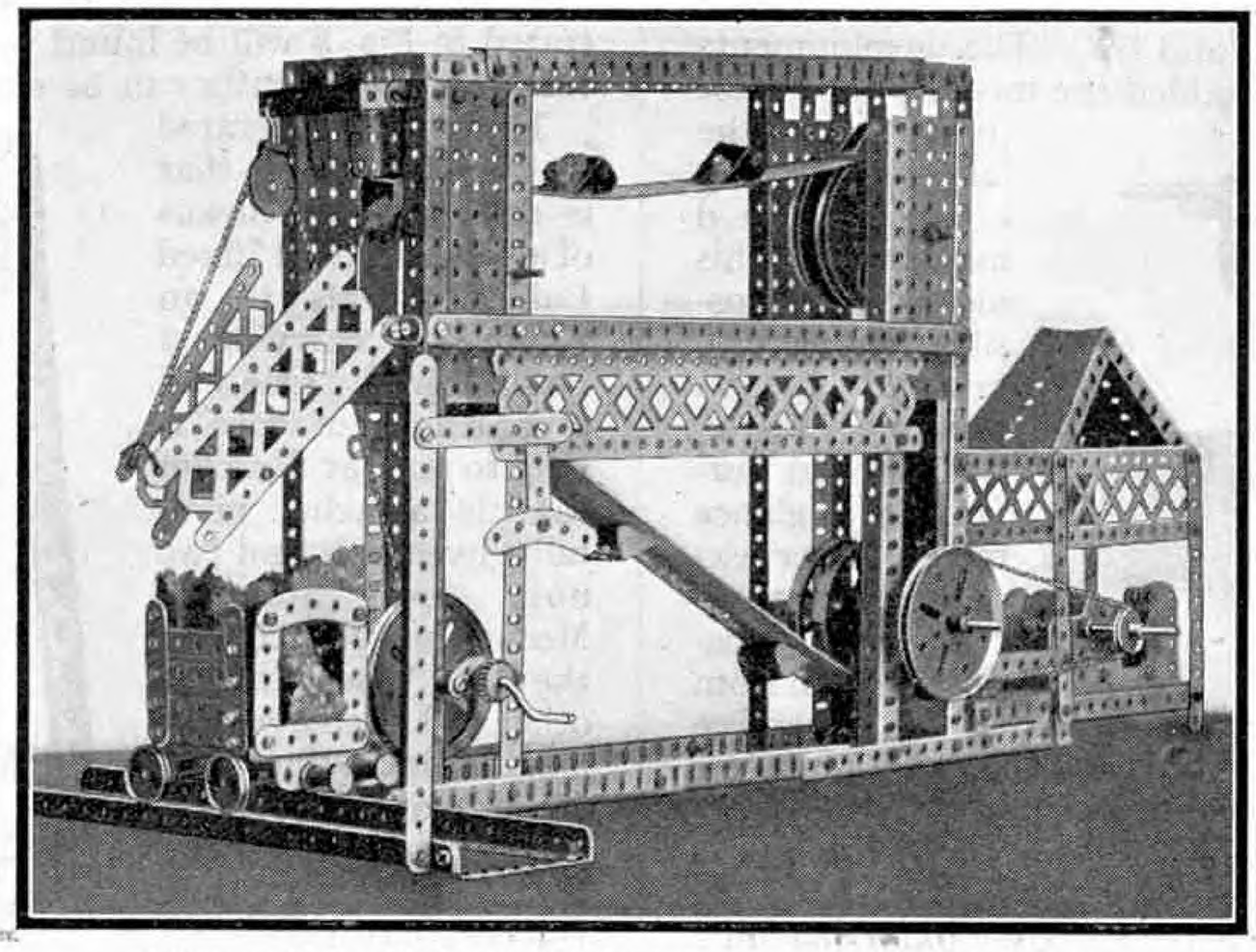
Stanley Brockett chose a novel subject for his model —that of a taxi-cab, and managed to reproduce the distinctive features of this type of vehicle. The model is fitted with a "fold down" hood over the passenger seat and a luggage rack is provided on the roof over the driver's seat. Numerous other details, such as a starting handle, lamps, etc., all help to give an excellent finish to the model.

J. C. Pearse secured his prize with a model of a high speed ore unloader. This model is on somewhat similar lines to the Meccano Ship-coaler, but it is of a more complicated nature. It consists chiefly of an elevated runway, which moves along the edge of the dock on rails specially provided for the purpose. On this runway a carriage mounted on wheels moves to and fro, and an arm with a grab attached to one end is connected to it. In operation, the carriage is first moved forward until the grab is directly over the hold of the vessel containing the ore ; the grab then takes up its load and the carriage is run back until the grab is over a railway truck, into which the ore is dropped.

An ingenious model of a slotting machine was sent in by Raymond Mitchell. In practice a machine of this type is used in shaping large castings, etc. The cutter moves in a vertical plane, and the speed with which the up and down strokes are made is controlled in the model by a clever reproduction of the Armstrong Whitworth quick-return motion incorporated in the real machine. The position of the material which is being shaped or slotted can be altered by means of worm mechanism actuating the work table.

Prizes in Section B

The First Prize in Section B was awarded to A. B. Horn for the model of a coal and coke conveyor illustrated on this page. This type of conveyor is used in gas works and similar places where coal or coke is required to be transported over a short distance into trucks or wagons. As will be seen the conveyor consists of an endless band with a series of Meccano Dredger Buckets attached to it. The material to be conveyed is picked up in the buckets at the bottom of the right-hand supporting tower and carried to the chute, through which it is deposited into the waiting wagons.



A Meccano Coal and Coke Conveyor, by A. B. Horn (First Prize, Section B)

Horne uses in his model a belt conveyor made of very tough paper but a rubber or cloth belt could be substituted if desired. The belt is carried around rollers consisting of three 3" Pulley Wheels bolted together and journalled at the top and bottom of each supporting tower.

Alan Hill, the winner of the Second Prize in this Section, submitted an interesting model of a motorcycle combination. His entry is illustrated on page 259 of this issue. The model incorporates a Meccano 4-volt Electric Motor, which supplies the motive power.

New Meccano Models

Miniature Mining Machinery and Equipment

IN the last two issues of the "*M.M.*" we dealt with fourteen simple models built with the smaller Meccano Outfits, and the following article includes seven more new models that may be added to the series. Last month we reminded readers that a group of models, bearing some definite relation to one another, often proves far more effective than a single large model using approximately the same parts.

We suggested the construction of a model factory, dock, or shipyard, and we propose this month to demonstrate still further the adaptability of the Meccano system by showing how the various kinds of machinery and equipment required for almost any large engineering undertaking may be reproduced in Meccano. For our particular subject we have chosen mining, on account of the large variety of machines used in this branch of engineering. In order to satisfy the requirements of all "*M.M.*" readers we have made the models as simple as possible, and the parts required for each model will be found in a No. 00 or No. 0 Outfit.

One method of obtaining a site on which to begin mining operations is, of course, to buy it, but our readers doubtless would prefer to discover one for themselves! We propose, therefore, to take them on a prospecting expedition into the wilds of northern Canada in quest of mineral wealth. Until recently the only way of exploring vast wastes of snow and mountainous country was to use sledges and dogs, and to cover the ground by a number of slow, laborious journeys to and fro. The developments of science, however, have enabled the modern prospector to fly over the land in a specially equipped machine. By this means it is possible, not only to travel incomparably faster, but also to survey at a glance much larger expanses of country than could possibly be seen from the ground. As aeroplanes are somewhat too expensive for the average person to buy ready-made, however, we will build one from Meccano parts.

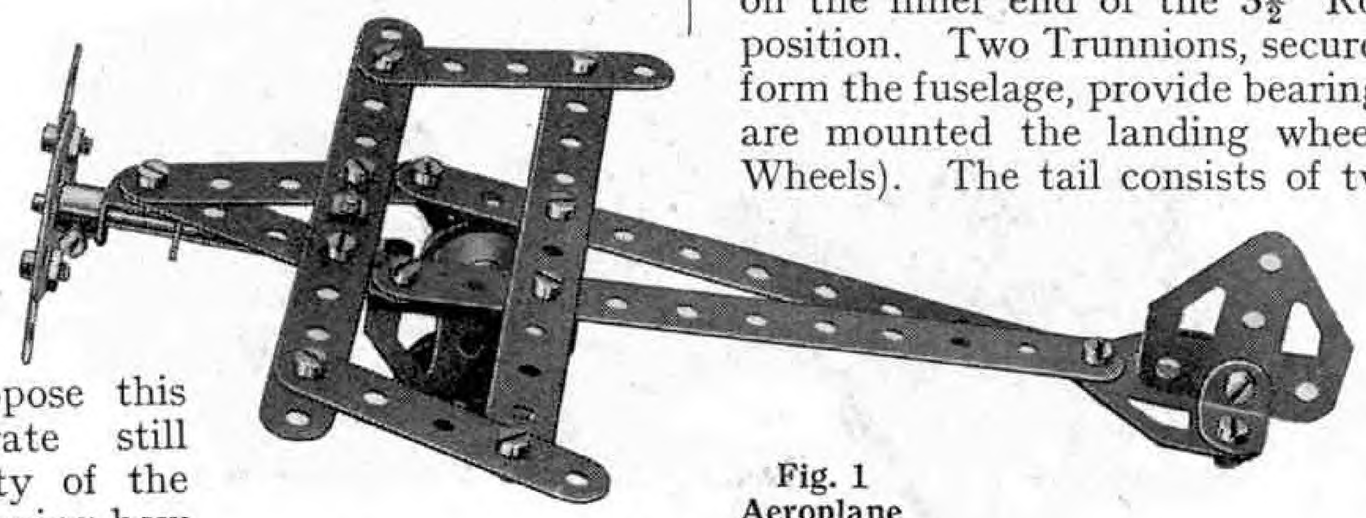


Fig. 1 Aeroplane

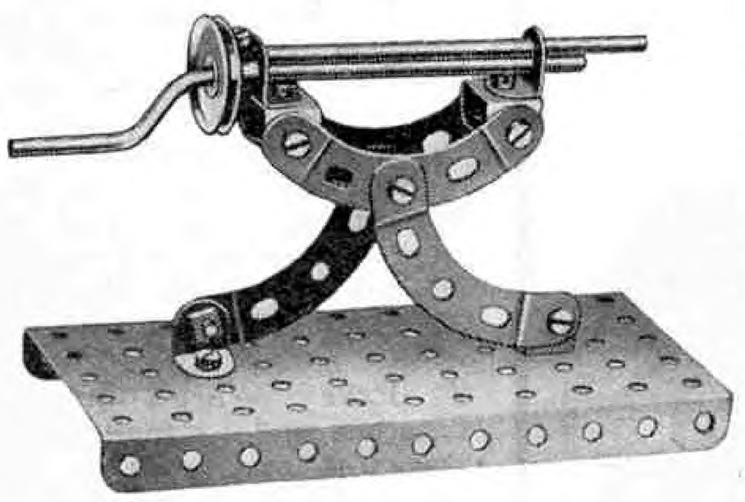


Fig. 2. Rock Drill

Model Aeroplane

The result of our labours is the speedy-looking machine shown in Fig. 1. As may be seen from the photograph its engine is perfectly simple both in design and construction, so it cannot possibly go wrong even in the extremes of cold that we are sure to encounter on our journey! The propeller, consisting of a Bush Wheel to which is bolted a 2½" Strip, is secured to a 3½" Axle Rod journalled in a pair of Double Brackets, and a Spring Clip on the inner end of the 3½" Rod retains the latter in position. Two Trunnions, secured to the 5½" Strips that form the fuselage, provide bearings for a 2" Rod on which are mounted the landing wheels (two 1" fast Pulley Wheels). The tail consists of two Flat Trunnions connected together by means of a pair of Angle Brackets.

When we have discovered a likely spot which, on application of our Meccano picks and shovels, gives some promise of yielding ore, we shall need a rock drill with which to carry on the work. This may easily be constructed as shown in Fig. 2. The Crank Handle and the 3½" Rod are both journalled in the same slotted holes of two Angle Brackets, which are bolted to Double Brackets supported by the upper pair of 2½" small radius Curved Strips. A rock drill of a slightly different type, running on wheels and having a swivelling movement, is shown in the No. 0 Instructions Manual (Model No. 19 in the Complete Manual).

Well-Drilling Machine

With such elaborate equipment at our disposal, we are almost certain to make a rich "strike," and it will then be necessary to erect the plant required to exploit our find. We will suppose that a deep shaft is to be sunk in fairly hard ground, and for this purpose the well driller illustrated in Fig. 3 will be found very useful. By the aid of this apparatus shafts can be sunk to almost any depth.

The model is operated by a Crank Handle that is connected by means of a belt and two 1" fixed Pulley Wheels to an Axle Rod carrying a Bush Wheel. One end of a length of cord is tied to a Flat Bracket that is attached pivotally by a bolt and two nuts (see Standard Mechanism No. 262) to the Bush Wheel, and the other end is led over a 1" fast Pulley Wheel secured to a 2" Rod at the top of the vertical member. When the Crank Handle is turned a 3½" Axle Rod on the end of

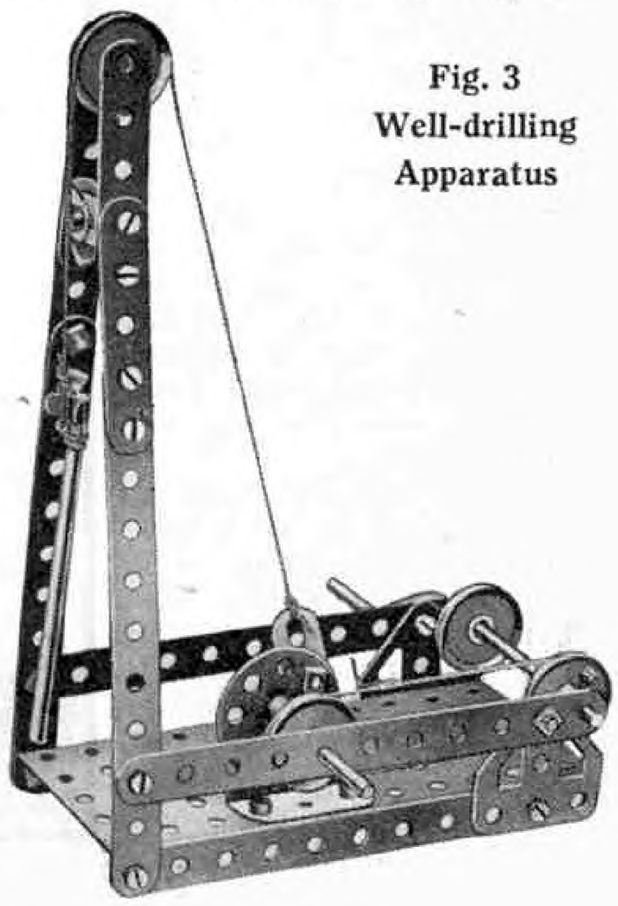


Fig. 3 Well-drilling Apparatus

the cord rises and falls with each revolution of the Bush Wheel. The length of the cord must frequently be adjusted so that the $3\frac{1}{2}''$ Rod strikes the bottom of the well every time it descends.

It is by means of apparatus of this kind that narrow bores, such as are required for oil wells, are drilled, but under special circumstances the prototype of our model may be usefully employed in the sinking of wider shafts for other purposes.

While operations are in hand for sinking the shaft, a pumping plant must be erected to cope with the water that continually flows into the mine, otherwise the workings would speedily be flooded. The pumps may be operated by the horizontal engine described on page 54 of the January *"M.M."*

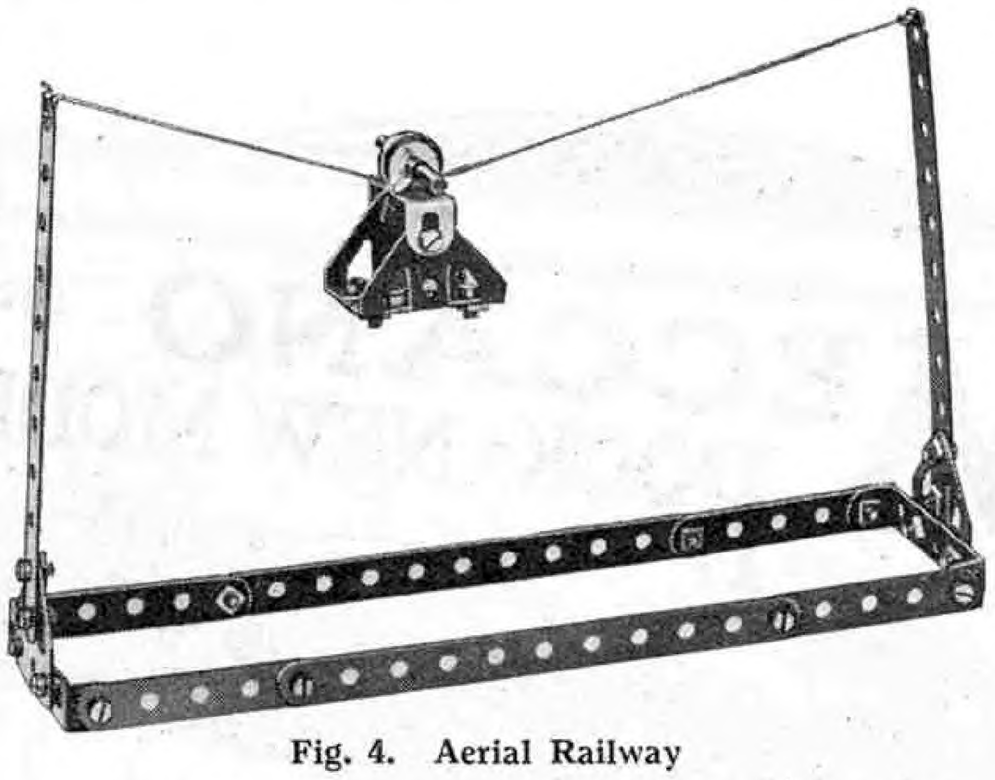


Fig. 4. Aerial Railway

In the case of a small mine, material can be carried up and down the shaft by a simple windlass, such as Model No. 23 in the Complete Manual of Instructions or No. 2 in the 00 Outfit Instructions Folder; for larger mines a cage and pithead gear should be devised. Preparations must also be made to dispose of the material as it is removed from the mine. The Tip Wagon and Dump Cart described in the January *"M.M.,"* together with some of the small trucks illustrated in the first part of the Instructions Manual, will serve admirably for use in and around the mine. For transporting loads for greater distances over rough country it is sometimes necessary to make use of an aerial railway similar to that shown in Fig. 4.

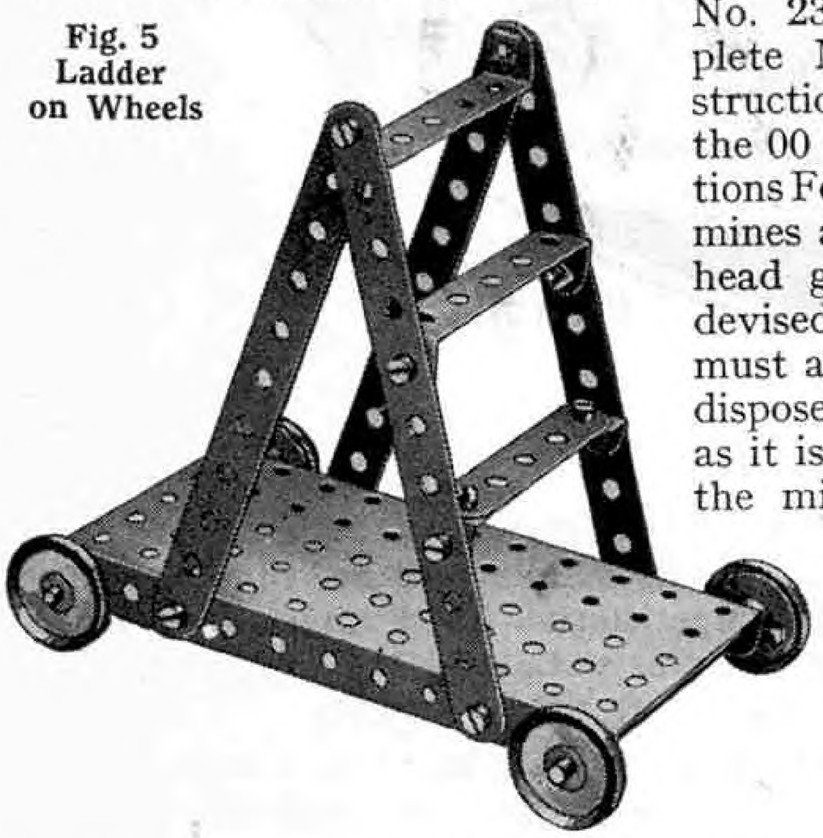


Fig. 5 Ladder on Wheels

Aerial Railway

In this model the trolley is composed of two Trunnions joined by Flat Brackets and suspended by two Reversed Angle Brackets from a $1\frac{1}{2}''$ Axle Rod that carries a $\frac{1}{2}''$ loose Pulley Wheel. The cable is stretched between two vertical $5\frac{1}{2}''$ Strips secured to Flat Trunnions, which in turn are bolted to $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips. In the photograph these Double Angle Strips are shown joined by $5\frac{1}{2}''$ and $2\frac{1}{2}''$ Strips, but if they are disconnected and secured by suitable means to any fixed objects, the distance covered by the trolley during each journey may be increased considerably. Aerial railways of this type can be used for despatching the products of the mine and for obtaining supplies, etc.

Passengers may gain access to the trolley of the aerial railway by means of the travelling ladder depicted in Fig. 5. The ore can scarcely be carried by hand up a ladder, however, and it will be necessary to provide some means for conveying it from the pithead to the end of the aerial railway. This work may be carried out by ordinary trucks or by means of a telpher span (Model No. 37 in the Instructions Manual), according to circumstances. The final process of loading the material into the trolley of the aerial railway will then be accomplished by cranes, of which the Manual offers no less than five distinct types that can be built from the No. 0 and No. 00 Outfits.

When the mine is actually working, the ore removed from it will be brought to an ore crusher similar to that shown in Fig. 6. Here it will be broken into small fragments, after which it will be sorted and sent away for smelting and refining.

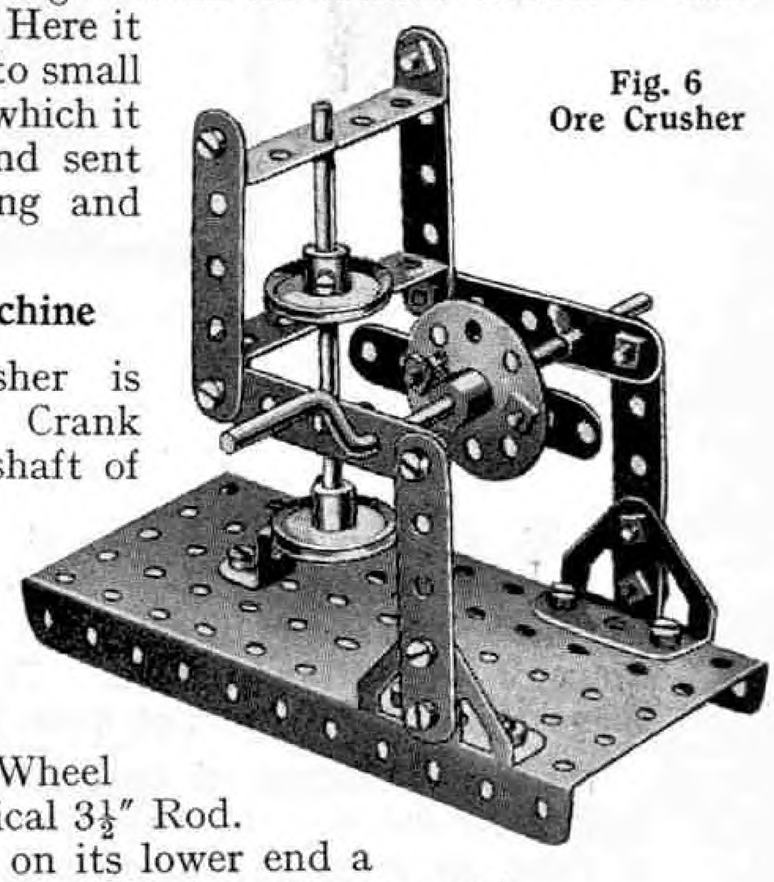


Fig. 6 Ore Crusher

Ore-Crushing Machine

The ore crusher is operated by a Crank Handle, on the shaft of which is secured a Bush Wheel. Two Flat Brackets, bolted to the Bush Wheel, alternately strike a $1''$ fast Pulley Wheel secured to a vertical $3\frac{1}{2}''$ Rod. This Rod carries on its lower end a second $1''$ fixed Pulley Wheel, and is arranged to slide in its bearings (two $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips) so that the lower Pulley Wheel, representing the massive weighted heel of the crushing machine, is lifted and dropped on to the ore twice during each revolution of the Crank Handle.

Among the various operations to be performed in connection with our mine, many uses will be found for a mechanical hammer. The specimen shown in Fig. 7 is a model of a tilt hammer—a type of machine which, together with the Helve hammer, was formerly in general use for most of the operations that are now performed by steam hammers, and is still employed in cases where the more powerful hammer is unnecessary.

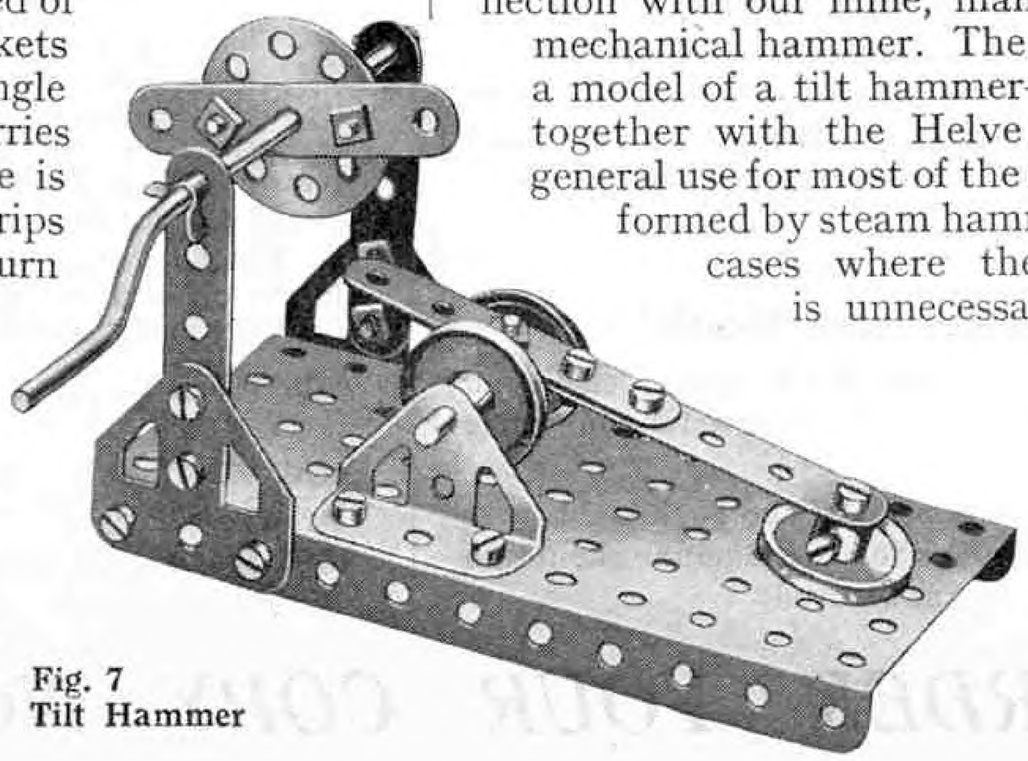


Fig. 7 Tilt Hammer

The Crank Handle carries a Bush Wheel to which is fixed a $2\frac{1}{2}''$ Strip. The ends of this Strip strike the end of the hammer shaft, so that the hammer rises and falls with each half-turn of the Crank Handle.



We are sure that all keen Meccano boys will be glad to know that " The Meccano Book of New Models " is now available. Nearly all the models, movements and new model-building ideas illustrated in this book are the direct outcome of prize-winning entries in recent competitions. They cover a wide range of interesting subjects. The Meccano Book of New Models also contains details of the best of the suggestions and ideas that have been published in the *Meccano Magazine* during recent months.

Large numbers of suggestions and bright ideas for new Meccano improvements reach us every day from Meccano boys all over the world. It is the task of our model-building department to select the best of these and to improve them as much as possible so that thousands of Meccano boys may benefit by becoming acquainted with their fellow-enthusiasts' work. Of course, few models are reproduced exactly as they are submitted by their designers—as a matter of fact several of the new models shown in the new book incorporate the ideas of three or four different Meccano boys.

It should be understood that this book is entirely supplementary to the ordinary Instruction Manuals, and many of the models illustrated are published for the first time.

Order Your Copy Early

The new book is now ready, and the price is 7d. post free. Only a limited number has been printed and to make quite certain of getting your copy you should send along your order *now*. All orders received will be dealt with in strict rotation.

How to Order the Book

Address your orders to " New Model Book," Meccano Limited, Binns Road, Liverpool, and please write your name and address clearly.

As already mentioned, the price of the book is 7d. post free, and a remittance in stamps for this amount should be sent. Orders will not be acknowledged.

Orders from Overseas

There is a special edition of the " Meccano Book of New Models " for Overseas. This is now ready and supplies are being sent to our agents for distribution. The price Overseas is 9d., or 10d. post free. Readers in Australia, New Zealand or South Africa who require copies should address their orders to our agencies as detailed below.

Readers living in countries other than those mentioned should order from Meccano Ltd., Binns Road, Liverpool, sending a remittance for 10d. with their order.

AUSTRALIA.—E. G. Page & Co., 52, Clarence Street, Sydney. (P.O. Box 1832).

NEW ZEALAND.—Models Ltd., Kingston Street, Auckland. (P.O. Box 129).

SOUTH AFRICA.—Arthur E. Harris, 142, Market Street, Johannesburg. (P.O. Box 1199).

ORDER YOUR COPY NOW !



This Month's New

Meccano Model-Building Contest

ANOTHER GREAT OPPORTUNITY FOR MODEL-BUILDERS

It should be the aim of every ambitious Meccano boy to enter each of the special Meccano Model-building Competitions, for they afford the valuable opportunity of measuring his model-building ability with that of his fellow Meccano boys. The experience gained by working in competition with others will not only broaden the competitor's outlook but will show him just how his work stands in relation with other experienced model-builders. In addition, when a Meccano boy enters a Model-building Competition he knows that he has an excellent chance of winning a valuable cash prize or a very useful quantity of Meccano or Hornby Train accessories.

Many boys are under the impression that they are not suited, or have insufficient experience, to compete in a Model-building Contest. This of course is quite a mistaken notion, for the simple act of building Meccano models from an Instructions Manual gives them all the experience that is necessary to put them on the road to success. No Meccano boy should consider himself "fully fledged" unless he competes in some, if not all, of the Competitions announced from time to time in these pages.

How to Compete

When you have decided upon the subject for your model, you should copy it faithfully and neatly in standard Meccano parts and then send in photographs or clear drawings of your model, together with any descriptive matter that you consider necessary. Remember, the two key words to success are "originality" and "neatness."

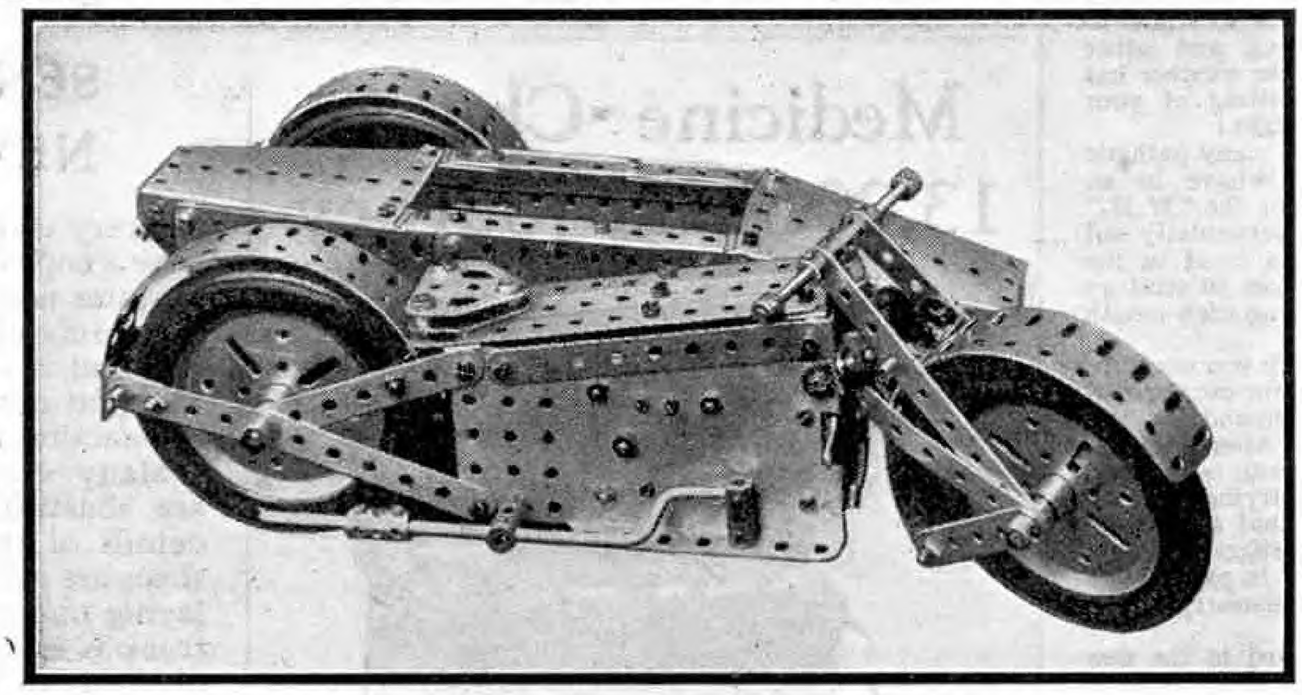
The best plan is to send a photograph of your model, of course, but if you cannot manage to obtain a good photograph a clear drawing will do as well. Neither photographs or drawings need be your own work, but the model itself must be the result of your own unaided efforts.

You should send in all necessary explanations concerning your model. These should be written carefully and neatly on one side of the paper only, and they should be as concise as possible.

Try to be as original as possible in the choice of your subject. Models that really work, or that may be put to some practical use, naturally attract the attention of the judges more than models that refuse to work or fail to reproduce the movements of their prototypes. Any number of parts may be used in the model, but it should be borne in mind that a simple model of straightforward design stands a better chance of coming out at the top of the list than a badly constructed, scrappy-looking model however complicated its mechanism may be. Good, sturdy construction will weigh heavily in the favour of any model.

There are no entry forms to fill in and no fees to pay. The only condition laid down is that the model must be your own unaided work as regards both design and construction.

The competition will be divided into three different Sections, as follows:— Section A for competitors residing in the British Isles and over 14 years of age. Section B, for competitors residing in the British Isles and under 14 years of age. Section C, for competitors of all ages residing overseas.



This excellent model of a motor-cycle and side car secured for Alan Hill, of St. Annes-on-Sea, the Second Prize in Section B of the "November" Competition, the results of which appear on page 254

Important Instructions

Do not send the actual model. Your photographs or drawings, if unsuccessful, will be returned providing that a stamped addressed envelope of the necessary size is enclosed with your entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Ltd.

The following instructions must be followed closely:—

More than one model may be entered in the competition, but all entries from any single competitor must be sent under the same cover. No single competitor can win more than one prize; if he sends two or three models they will be considered jointly when awarding the prize.

If suitable, many prize-winning models will be included in forthcoming Instructions Manuals and other Meccano publications, so that they may be rebuilt again and again by Meccano boys of all nationalities.

Your name and address must appear on the back of each photograph or sheet of paper used, together with your age, name of the competition ("March" Model-building Competition) and the Section in which the model is entered. Address the envelope "March Competition," Meccano Ltd., Binns Road, Liverpool.

Entries for Section A and B must be received by 30th April, 1928. Closing date for Section C: 31st July, 1928.

THE PRIZES

The Prizes to be awarded in Sections A and C are as follows:—

First Prize: Cheque for three guineas.
Second Prize: Cheque for two guineas.
Third Prize: Cheque for one guinea.
Six prizes, each consisting of Meccano products to the value of 10/6.
Twelve prizes, each consisting of Meccano products to value 5/–.

The Prizes in Section B are as follows:—

First Prize, Meccano products to value two guineas.
Second Prize: Meccano products to value one guinea.
Third prize: Meccano products to value 10/6.
Six Prizes, each consisting of Meccano products to value 5/–.
Twelve Prizes, each consisting of a Complete Instructions Manual.

A limited number of Certificates of Merit and complimentary copies of "Meccano Standard Mechanisms" Manuals will be awarded in each Section.

OUR MAIL BAG



In this column the Editor replies to letters from his readers, from whom he is always pleased to hear. He receives hundreds of letters each day, but only those that deal with matters of general interest can be dealt with here.

Correspondents will help the Editor if they will write neatly in ink and on one side of the paper only.

F. Marquand (Woodville, N.Z.)—"I was busily building a fowl-house but when your letter arrived I dropped my tools and sat on top of the run and read it!" This sounds like the real spirit of enthusiasm, Frank. Your sketch of the Editor as you imagine him to be is not at all flattering but it made us laugh, so you are forgiven! We may just hint that we are not quite 94 years of age and that, although a certain scarcity has begun to be obvious, we still have more than one hair!

D. Garnett (Loughborough).—Your comments on the Magazine are very welcome, all the more so because you realise that certain subjects that do not appeal to you personally are of great interest to thousands of other readers. We quite agree that Mr. Gauld's articles are "super-excellent." We hope that he and Mr. Allen will be among our regular contributors for a long time to come. You will be glad to hear that there will be several more interesting instalments of Mr. Hornby's tour round the world.

J. King (Niton, I.O.W.)—It is good to hear that your friends often bring their "*M.M.'s*" to school to assist in studying various engineering and other subjects. We are not surprised that the weather has changed several times during the writing of your letter seeing that this occupied a fortnight!

L. A. Prior (Boscombe).—We receive many pathetic letters from readers whose fathers behave in an entirely unjustifiable manner on the day the "*M.M.*" arrives, but your case appears to be particularly sad because your grandfather also takes a hand in the business! You will either have to resort to strategy or persuade your elders to buy two copies each month instead of one.

J. A. King (Adelaide, S.A.)—We think you would be surprised if you could glance through our correspondence and realise how great is the demand for still more articles on railway subjects. After all, the "*M.M.*" must be primarily concerned with mechanical matters, and we have no intention of trying to cover the same ground as other magazines that are largely devoted to fiction and games. Your suggestions are interesting, however, and we have now in preparation an interesting series of articles on chemistry which we hope will appeal to you.

J. Masters (Cheltenham).—"In regard to the new "King" class engines, all I can say is Mr. Collett is the man to give pains to all the mechanical engineers in England!" Your enthusiasm for the G.W.R. is quite refreshing, but we do not think you ought to discourage all rival locomotive engineers quite so ruthlessly! We will tell Mr. Allen you are cross with him for dealing with the "*Flying Scotsman*" before the "*Cornish Riviera Express*!"

A. Hodgkinson (Fleetwood).—We quite envy you your recent sea trip to London and you must have had a royal time—except during one little period when you were not very well! The accident when you were off Penzance must have provided quite a thrill; in the circumstances we think you ought to forgive the engineers for using one or two "swear-words!"

G. Allen (Sheffield).—"It was searching for an engineering paper that finally caused me to buy the "*M.M.*" I wish I had known of it before." We wish so too, George, but better late than never. As you are interested in Naval matters we shall be glad to have your opinion of the article on battleships in the "*M.M.*" for last November.

J. G. Lowe (Caithness).—Your review of the various features of the "*M.M.*" is one of the most interesting we have ever received. Your letter makes us realise what the "*M.M.*" means to readers who are as keenly interested in it as yourself and encourages us in our efforts to improve the magazine still further.

L. W. S. James (Glasgow).—"I am delighted with my prize. The colours are a great improvement to Meccano. My first model of a pit-head gear looks fine." The joy in every line of your letter has infected the whole of the Editorial Department.

S. F. Desai (Navsari, India).—"Thirty-three trippers took their trains to Trincomoli; they tittered, they tattered, they talked together; they took their tea, till the three-thirty train took them to their towns." It is quite evident that these poor trippers were very restricted in their refreshments. They might, of course, have had tarts or toffee, but not much else. Perhaps some of our readers can tell us how "master minds make Meccano Magazines." The best effort will win five shillings.

Wireless Valves for Every Purpose

An interesting booklet giving details and illustrations of valves for wireless reception has been issued by A. C. Cossor Ltd. Cossor valves have always had a high reputation and the recent introductions fully maintain this standard. Their filaments are characterised by a high rate of emission at low temperatures, and strength is ensured by the method of mounting the filament, grid and anode on a seonite insulator. The result is a valve of which a dozen samples were dropped from an aeroplane at a height of 500 ft. without damage to the filaments resulting.

A full range of valves to suit all purposes is manufactured by the firm in three series requiring two, four and six volts respectively to heat the filaments. Two of the valves illustrated are specially notable. These are a screened-grid valve and a new valve specially designed for use with electric light mains. The latter has a four-pin base of the ordinary type and in addition has two filament terminals mounted on top of the valves. These are to be connected to the terminals of a special unit that transforms the voltage of the mains into one suitable for the filament.

Veeder Cyclometers

The Veeder Cyclometer has enjoyed a high reputation among cyclists for some forty years. Its original design and construction were so good that very little alteration has been necessary since its introduction. The latest model has an extended mileage range and improved protection from wet and mud. These features will be welcomed by the large number of all-weather cyclists of to-day, more particularly since they are not accompanied by any increase in price.

Full particulars of the Veeder instruments and of the method of fitting and using them are contained in an interesting little booklet issued by F. E. Dickinson, St. Andrew's House, Holborn Circus, London, E.C.1.

Medicine Chest's 13,000 Mile Journey



Regular readers will remember the interesting article that appeared in the "*M.M.*" for November, 1926, in which was described the remarkable 13,000-mile journey made throughout in open cars by Major and Mrs. Court Treatt from the Cape to Cairo. Many difficulties were encountered en route, but the party made light of them, and thought nothing of hewing a road through the primeval forest when other tracks failed. In addition to the minor injuries inseparable from such work, the intrepid motorists had constantly to beware of the venomous insect and reptile life of what, in parts, may still truly be called "The Dark Continent."

Perhaps the most difficult section of the journey was across the great desert south of the Sudan. Many and grave were the warnings the party received on all sides not to persist in the attempt—even the Arabs there had never ventured with their camels on this trackless waste. Nevertheless, the desert was safely crossed.

The interesting news is now to hand that throughout the arduous journey the expedition relied solely for their medical supplies on a single "Tabloid" Medicine Case measuring less than 6 ins. in height and under 12 in. in length. No amount of rough transport or extreme of climate had any deleterious effect upon this small medicine case, which from start to finish supplied everything that was needed in the way of bandages, dressings and medicaments.

How to get more fun out of Hornby Trains



SEND FOR THIS NEW BOOKLET

Every owner of a Hornby Train should have a copy of this splendid new book for it contains much useful information concerning miniature railways. All enthusiasts will find it of great assistance in enabling them to obtain the utmost pleasure and satisfaction from their hobby.

Many very interesting rail formations are illustrated in the booklet and full details of the rails required to construct them are given. As every boy knows, the laying out of a realistic and well-planned track is essential if the maximum amount of fun is to be obtained.

The running of Goods and Passenger Trains in accordance with correct railway practice is dealt with in detail, even to the extent of showing the intricacies of time-table working. Shunting and signalling are also described in an interesting and simple manner.

The price of the booklet is 3d., and if you cannot obtain it at your dealer's it will be sent post free on receipt of 3d. in stamps. All applications should be addressed to Department MA., Meccano Limited, Binns Road, Liverpool.



SHUNTING WITH A HORNBY TRAIN IS FINE FUN

Competition Page



Which were the Most Popular Covers in 1927?

In the above illustration the beautiful coloured covers that appeared on the various issues of the "*M.M.*" during 1927 are displayed in reduced form in their published order—January to June in the upper row, July to December in the lower.

The "*M.M.*" covers are among the most striking that are published to-day and, therefore, it is not surprising that opinions should differ as to the most effective cover of each volume. Many readers will recall the highly interesting voting contests held to adjudge the best covers of our 1925 and 1926 volumes, and we are sure everyone will welcome the opportunity of expressing an opinion on the 1927 covers.

The reproductions are intended for reference purposes only, but new readers will find them of great assistance in forming their judgment. On the other hand, those readers who possess copies of the 1927 magazines will be well advised to compare the originals, for the beauty of the designs depends largely upon their colouring.

Referring to each cover by its month of issue, each competitor is asked to write on a post card his (or her) idea of the order of popularity of the 1927 covers as decided by the massed vote of all the competitors. Having prepared this list each competitor must underline the cover he likes best of all. The entrant's name and address must be added to the card, which should be addressed to "Cover Voting Competition, Meccano Magazine, Binns Road, Liverpool." Each list must cover the whole year and competitors may send as many entries as they wish provided that each is on a separate card.

Prizes of Meccano goods (to be chosen by the winner) to the value of £1/1/–, 15/–, 10/6 and 5/– respectively will be awarded to the four competitors whose lists most accurately forecast the final result. In the event of a tie for any of the prizes preference will be given to the entry displaying the neatest or most novel presentation. In addition there will be a number of consolation prizes. Closing date, 31st March. Overseas, 30th June.

Correspondence Invited

There is a wide divergence of tastes among our readers, a fact that is clearly indicated by the comments of those who write us from time to time, criticising this feature or that and suggesting the substitution of something else. We welcome criticism of the right kind and appreciate greatly the friendly interest that leads the critic to write.

There are many thousands of our readers from whom we have never heard. Their silence may be taken to indicate contentment, but nevertheless we want to hear from them. This competition has been designed to give each reader an opportunity—or excuse!—to tell us "What feature of the "*M.M.*" he likes least; why he dislikes it; and with what feature he would replace it."

Entries to this competition must be in the form of a letter addressed to the Editor. Each competitor must write his name, age and address at the head of his letter together with the words "Critics' Letter Contest." Entries will be divided into two sections, A and B, the former for those aged 16 and over, the latter for those under 16. Prizes of Meccano products (winners' own choice) to the value of £1/1/– and 10/6 respectively will be awarded to the best and second best letter in each section. There will be a number of consolation prizes also.

Closing date, 31st March. Overseas, 30th June.

Home Results

January Sharp Eyes

In a spirit of undue optimism we announced our belief that this advertisement contest would prove a teaser. Vain beliefs! Within two or three days of the announcement of the contest entries commenced to pour in and once again the oft repeated truth that Meccano boys are amazingly keen sighted, must be placed on record.

The Overseas section is still open and we cannot give the solution at the moment, but this will appear in due course. The awards were as follows:—

1. I. P. Duxbury (Margate); 2. G. E. Pepper (Dublin); 3. W. M. Cassie (Coatbridge). 4. L. A. Murray (Small Heath, Birmingham). Consolation Prizes: E. Cotton (Hayes, Middx.); C. H. Lyons (West Harptree); A. Marshall (West Derby, L'pool); V. Murrell (Westcliff-on-Sea); V. H. Tregoning (W. Norwood, S.E.27); G. R. Trump (Bristol).

Railway Plan

Some extremely elaborate and many ingenious layouts for model railways were submitted in connection with this contest, but all too many of the competitors forgot that the satisfactory operation of a railway connecting two well designed and busy termini demands at least a double track. Herein lies the failure of many really excellent plans. It is not possible at this stage to criticise the plans in detail and in this announcement we must content ourselves with that brief generality. The awards were as follows:—

First Prizes: Section A, R. Butterworth (Manchester); Section B, J. T. Darch (Surrey). Second Prizes: Section A, R. Gibbons (Liverpool); Section B, L. T. Levitt (Plaistow, E.13). Consolation Prizes: D. G. Shadbolt (Cambridge); J. W. Lowe (Birmingham).

Canadian Essay

First Prizes: Section A, W. C. Stokes (Atherstone); Section B, J. Merrett (Bridgwater). Second Prizes: Section A, R. E. Davies (Holywell, N.W.); Section B, J. R. Plenderleith (East Sheen, S.W.14). Owing to lack of space it is not possible to give a list of the consolation awards.

OBJECTS of the GUILD

To make every boy's life brighter and happier.

To foster clean-mindedness, truthfulness, ambition and initiative in boys.

To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.

The Meccano Guild

With the Secretary

Plans for the Outdoor Sessions

It is by no means too early to think of plans for outdoor sports and amusements during the coming summer, as the success of these is largely dependent on careful preparation. No doubt many Leaders and secretaries have already begun to consider plans for cricket, cycle runs, walking expeditions or a summer camp, and now is the time to hold a conference in order to find out which of these and similar activities make the widest appeal to members. I hope that secretaries will inform me in good time what their clubs have decided upon, particularly if any new and bright ideas have been thought out.

A summer camp should certainly be included in the programme if at all possible. In many clubs this is an annual institution, and the members are fully competent to choose sites and to provide suitable equipment. For the benefit of others, I intend in future issues to give some guidance on these points, and it would be very helpful if some of the veterans were to draw upon their own experiences in order to assist the recruits to have an enjoyable time under canvas.

A Novel Competition

The Herne Bay M.C. has arranged an interesting competition of an entirely new type. This club was one of the earliest to produce a club magazine, "*Strips and Cranks*," its official organ, making its first appearance as long ago as 1924. This was followed last year by "*Chat*," described by its ambitious producer as the "UNofficial organ" of the club, and now the Leader has been so impressed by the productive power of the members, that he has offered prizes for competition among budding editors.

Already several entries have been received, and it is quite clear that the competitors are not deterred by the condition that at least six consecutive issues must be published by June next in order to qualify for a prize. The magazines are of the pass-round variety, one copy only of each number being produced by the editor himself and circulated among the members of the club. I have been asked to act as judge in the competition, and if the copies that have already reached me are a fair sample of the entries, the task of deciding between them will be no easy one. The contents of those I have examined are bright and breezy, the illustrations good, and their general get-up shows that the editors understand the art of giving their productions an attractive appearance.

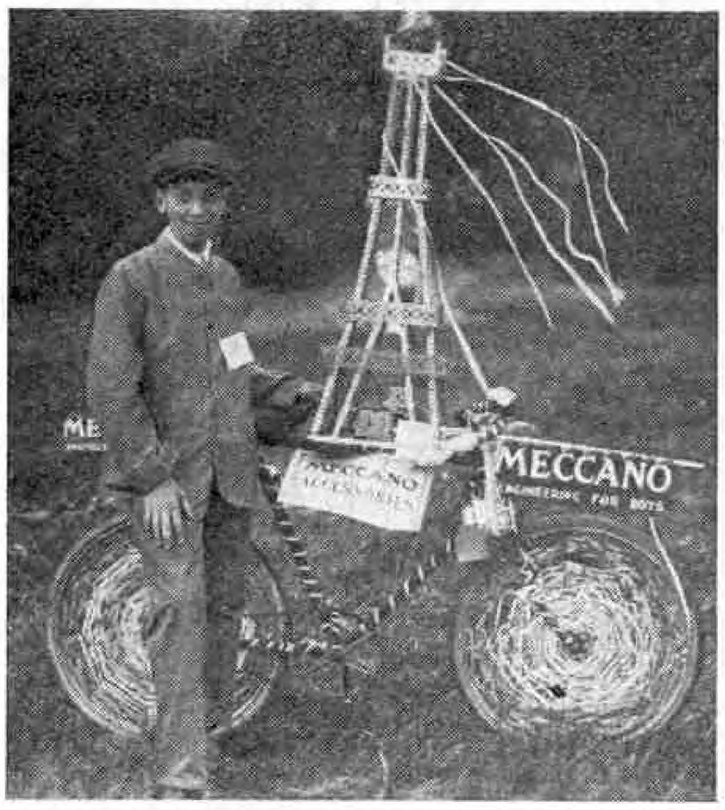
Value of a Club Magazine

While on this subject, I would like to remind Leaders and secretaries of the great value of a club magazine in promoting a spirit of unity among their members. Nothing pleases the latter more than to read every month a summary of the club's activities, the results of competitions or discussions of prospects and intentions, to say nothing of articles and stories from various sources. In addition, it provides an outlet for the artistic talent that is to be found in most clubs.

One objection that has been raised to the production of a magazine is that it entails a great amount of labour. The actual amount depends on the size of the magazine, and it is a simple matter to keep this within practical limits. One copy must, of course, be written out, but even in the case of comparatively large magazines, the whole of the work need not fall upon the editor, as he may obtain the assistance of a small committee, the members of which would divide the work between them.

Meccano Club Secretaries

No. 10. E. H. Davies



E. H. Davies is the energetic secretary of the Uttoxeter M.C., and was chiefly responsible for its foundation in 1926. He is also an enthusiastic cyclist, and as our photograph shows, made effective use of Meccano in decorating his machine for a fancy dress carnival, in which he was awarded Second Prize.

Easy Production Methods

A pass-round copy has proved quite satisfactory in many clubs—the well-established Herne Bay magazine takes this convenient form—but it is probable that most club members would prefer to have copies of their own. This involves the use of a duplicating device of some kind. The most popular method is to use the reliable "jellygraph," which may be bought or made for a very small sum and will prove useful in many other directions. Reproduction in this manner has the additional advantage that a small charge may be made for each copy—provided of course, the size and contents of the magazine justify it—in order to cover the incidental expenses of production.

Most of the magazines that reach headquarters are reproduced on the jellygraph, but it has occurred to me that a great gain in neatness and legibility would probably result from the use of a simple printing set. The "Adana" outfit advertised in the columns of the "*M.M.*" is of the type I have in mind. The use of this machine requires a little practice, and for magazine work more type than is originally supplied would be required, but once these matters have been attended to it is possible to print a magazine that has a really professional appearance.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places, and boys interested in becoming members should communicate with the promoters, whose names and addresses are given :—

BRISTOL.—K. White, 20, The Square, Knowle Park, Bristol.

BURTON-ON-TRENT.—Frank Kerry, 39, Wood Street, Burton-on-Trent.

CARDIFF.—A. Rossiter, 13, Woodville Road, Cathays, Cardiff.

GALWAY.—Noel Glennon, 28, Nuns Island, Galway, Ireland.

LONDON.—N. Van Perlstein, 13, South Ridgway Place, Wimbledon, S.W.19.

LONDON.—Jim Draper, 13, Barlby Gardens, North Kensington, W.10.



CLUB NOTES



Middlesbrough M.C.—The club's second anniversary was celebrated by a successful social evening. The hall specially engaged for the occasion was gaily decorated, and with refreshments and games a most enjoyable evening was spent. The secretary and assistant Leader paid a visit to the newly-affiliated West Hartlepool M.C., who gave them a hearty welcome, while the Middlesbrough club received a visit from the secretary of the Darlington M.C. Joke Night secured the highest number of votes in a competition recently organised to find which was the most enjoyable night of the session. Club roll: 54. *Secretary*: A. Bradley, 95, Deepdale Avenue, Marton Grove, Middlesbrough.

Bailieborough (Co. Cavan) M.C.—Was recently affiliated to the Guild and is making satisfactory progress. The programme for the session includes Model-building, Competitions, Games Nights and Puzzle Evenings. New members will be made very welcome, and those wishing to join should write to the secretary for full particulars. Club roll: 8. *Secretary*: R. A. Laven, Bank House, Bailieborough, Co. Cavan, Ireland.

Sheffield M.C.—Excellent progress is being made and the club roll shows a steady increase, making the provision of a larger club room necessary. Model-building and other interesting activities figure on the syllabus, and the club possesses a fine railway. Meetings are held at 6 o'clock on Friday evenings in the Fullwood Vicarage Parish Room. Club Roll: 23. *Secretary*: K. Stacey, 128, Peveril Road, Sheffield.

Herne Bay Meccano and Hobbies M.C.—Well organised Games Tournaments are a feature of club work, a Stamp Collector's Competition recently held proving most interesting. A competition for amateur magazine editors has been arranged, the efforts of the competitors to be judged by the Guild Secretary. The programme includes Model-building, Games Tournaments, Hobbies Nights and many other interesting items. Club roll: 39. *Secretary*: Clifford W. Russell, 4, Clifton Villas, Herne Bay.

Collegiate Schools M.C.—A Hornby Train Night held recently proved highly successful and the syllabus includes many interesting subjects. Several lectures have been given by various members. The club's second birthday was celebrated by a Social Evening. Club roll: 34. *Secretary*: K. Walden, 18, Old Park Road, Palmers Green, London.

Elm Road (Beckenham) M.C.—A Lecture on "*Wireless Crystal Sets*" given by the Leader was greatly appreciated. Model-building Nights are frequently held and Hornby Nights are arranged from time to time. Club roll: 18. *Secretary*: C. W. Price, 52, Queens Road, Beckenham.

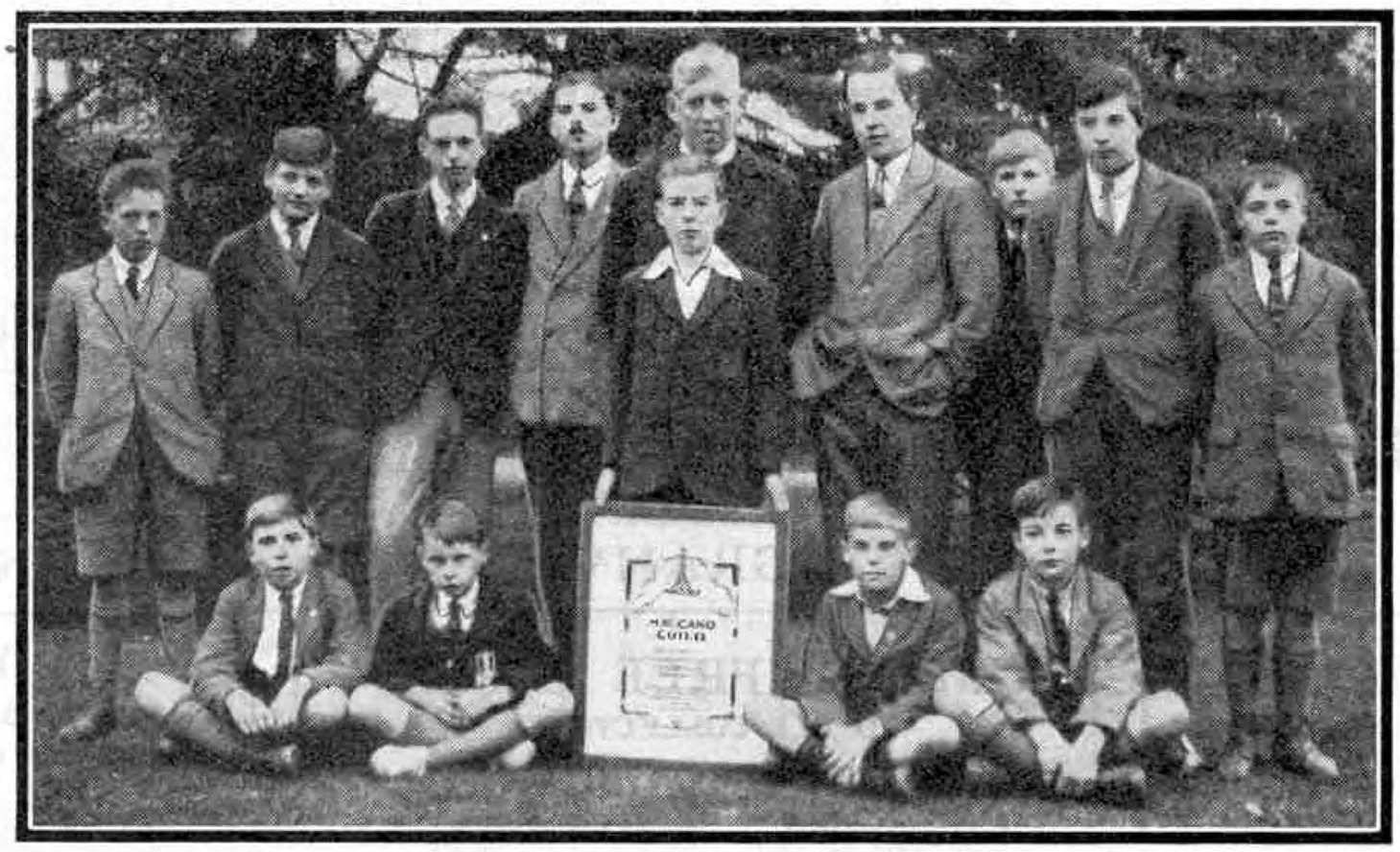
St. Peter Mancroft (Norwich) M.C.—Hornby Train Nights are frequently held, and several fine layouts have been on view. Debates are held from time to time and are well supported. A most interesting lantern lecture entitled "*The Far East*" was given by a lady who has just returned from an expedition to the East. Stamp Collectors' Nights appear frequently on the programme. A Contractors' Night has been held, the contract to build a bridge being won by a section under the Secretary. Club roll: 60. *Secretary*: Lionel H. Oates, Bonfire, Blofield, Norwich.

Willingham M.C.—The attractive programme includes Model-building, Fretwork and Woodwork. Plans are already being discussed for an Exhibition to be held in the summer. Club roll: 14. *Secretary*: A. J. Huckell, Short Lane, Willingham.

Holy Trinity (Barnsbury) M.C.—The club had a stall in the Church Sale of Work and this did very well. A Parents' and Friends' Night was very enjoyable and many prizes were awarded by the Rev. T. G. Mohan. Club roll: 50. *Secretary*: Frederick W. Johnson, 23, Market Street, Edgware Road, Paddington, London, W.2.

Halifax M.C.—A very successful Exhibition has been held, at which many excellent models were displayed. These included a Windmill driven by a Steam Engine, and a Meccanograph, the latter attracting much attention. A lecture on "*Bridges*" was given on another evening by the Leader. The club is fortunate in possessing a fine library which is well patronised. Club roll: 28. *Secretary*: C. Walton, 22, Milton Street, Halifax.

Willingham Meccano Club



This club was established in February 1927, and was affiliated in June of that year under the Leadership of Mr. D. E. G. White. Since the time of affiliation excellent progress has been made. In addition to Model-building the club specialises in Fretwork and Stamp Collecting

Victoria (Glasgow) M.C.—A very interesting discussion on "*The Relative Merits of British and American Engineers*" was held recently. Model-building still occupies first place in club activities and many interesting models are made. Club roll: 42. *Secretary*: Henry C. Thompson, 4, Montgomerie Gardens, Scotstoun, Glasgow.

Buckhurst Hill M.C.—Reports good progress. A special effort is being made to recruit new members, and the secretary will be glad to hear from any boy who wishes to join. Club roll: 9. *Secretary*: Denis Mason, "Lyndale," Palmerston Road, Buckhurst Hill, Essex.

Annan M.C.—A most successful dance was held recently and quite a large sum was realised. The programme includes interesting Lectures, Model-building and Games. An interesting feature is shooting and some very enjoyable evenings have been spent in this way. Contractors' Nights are held frequently as the members are keen model-builders, the last contract competed for being the building of a bridge. Club roll: 25. *Secretary*: William T. Duff, 10, Hecklegirth, Annan.

St. Albans' M.C.—Recent activities included a visit to the local Electricity Station and a Mock Trial. The latter was an open performance in aid of the club funds, and a satisfactory sum was realised. The leading characters were given the names of Meccano parts, and each wore the appropriate part. The opportunity was also taken to present the Leader with a small gift in recognition of her services in this capacity for the last two years. Club roll: 19. *Secretary*: H. M. Upward, 19a, Worley Road, St. Albans.

Stoke and Newcastle M.C.—An excellent club room has now been secured and meetings are held fortnightly. A very interesting syllabus is being followed and includes Model-building, Hornby Train Evenings and Games Evenings. Games Tournaments are not on the knock-out principle; each boy plays every other member and points are given. Prizes are to be awarded on points at the end of each tournament. A Primus Junior lantern has been purchased. Club roll: 11. *Secretary*: P. F. Taylor, 6, Poolfield Avenue, Newcastle, Staffs.

Sparkhill M.C.—Excellent progress is being maintained. Lantern Lectures and Model-building figure largely in the syllabus. Debates are also interesting items. These are arranged without preparation. Club roll: 18. *Secretary*: E. L. Stewart, 44, Benton Road, Sparkhill, Birmingham.

Withington M.C.—A fine Hornby Layout has been installed in the club room and is proving very attractive to the members. A "Do-as-you-like" night and the annual party were other popular features, while Lantern Lectures are now to be arranged. Club roll: 13. *Secretary*: K. Cradduck, 36, Mauldeth Road West, Withington, Manchester.

St. James M.C.(Wath-on-Dearne).—Shooting has been introduced and is proving very popular. Several club nights have been devoted to model-building, some very good models having been produced. It is hoped to give the play "*Nonsense Nana*" soon. The club roll is slowly increasing and intending new members should write to the secretary for full particulars. Club roll: 7. *Secretary*: Eric Brown, 52, Beech Road, Wath-on-Dearne.

Diss Church M.C.—At a Social Evening a sketch was given by several of the club members. Songs by Mr. M. Golding, the assistant Leader, accompanied by the Rev. F. P. Law, also figured on the programme. Club roll: 34. *Secretary*: J. J. Maling, 6, Mount Pleasant, Diss.

Westbury M.C.—Is progressing satisfactorily. A lantern lecture loaned from the de Havilland Aircraft Co. provided an interesting night. The slides and accompanying descriptions dealing with the various types of aircraft produced by that company. Club roll: 30. *Secretary*: Eric Moye, 24, Burnell Rise, Letchworth.

Clubs Not Yet Affiliated

Dunoon District M.C.—The first meeting of the club was a great success and 13 members attended. A model of a Swing Bridge provided an interesting discussion at one meeting. The number of members is now 14, and more members will be enrolled when a larger room has been secured. *Secretary*: Willie D. Laird, Parkroyd, Victoria Road, Dunoon.

Weston-super-Mare M.C.—The first meeting of this promising club was a success, and the club roll is now rapidly increasing. Each new member is expected to pay a small sum towards the funds when joining the club, and the club is then able to carry on without any other subscription. An exhibition is being planned and prizes are to be given in several classes, to suit the members. The secretary gave a talk at a recent meeting on "*Major Segrave's Car.*" *Secretary*: Peter Rowell, 4, Royal Crescent, Weston-super-Mare.

Plumstead M.C.—Mr. H. Angus has undertaken to act as Leader of this new club, and application for affiliation is to be made immediately. *Secretary:* S. E. Weller, 22, Woodhurst Road, Plumstead, S.E.18.

A Record Demand

The demand for the fine Gibbons Approval Sheets has been so great during the last month or two that we have had to make up hundreds of new sheets.

This proves that other fellows like them. Why not follow their example and write for a fine sheet of stamps of the country you are keen on.

Album and Packet List Free.

STANLEY GIBBONS LTD.

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4/9 PACKET FOR 7½D.

Genuine bargain offer of 25 picked Stamps, cat. value 4/9. **All** good stuff, as Australia (**Canberra**), SIR-MOOR, rajah, cat. 1/–, **Tanganyika,** giraffe, Hungary (**Turul Bird**), VICTORIA, 20c. Kenya, **mint** B. Congo 1889 (**King Leopold**), pictorial TASMANIA, 3d. N. Zealand K.E., SPANISH Morocco, **French** Morocco pictorial, SYRIA (on Pasteur), large **Sweden** (official), CUBA (ship), Greece (**Hermes and Arcas**), with the rest equally attractive. Special for approval applicants only, 7½d. post free.

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All different and postally used. **Post Free 1/6.**
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Duplicate Stamp Album : Set 12 Australian : 100 Different Stamps FREE!!

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A magnificent offer, 100 different stamps (40 unused), a useful 20-page duplicate album, and the fine set of 12 Australasian stamps. Just request our famous approvals.

LISBURN & TOWNSEND, LONDON ROAD, LIVERPOOL

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Free! 50 Different British Colonials

This wonderful gift packet contains 2 Jamaica (pictorial), 5 Australia, 1 Malay (tiger), 10 Canada, 1 Cochin (rajah), 1 Deccan, 4 Ceylon, 1 Gold Coast, 1 Nigeria, 1 Travencore, 4 New Zealand, 1 Queensland, 1 Straits, 5 Union South Africa (including new issue), 9 Irish (set with high values). ABSOLUTELY FREE TO GENUINE COLLECTORS REQUESTING APPROVALS. Also those sending 3d. for postage, etc., receive fine set of 100 unused German, all different.

SPECIAL OFFERS.—50 diff. French Colonials, 7d.; 100 diff. 1/6; 50 diff. Portuguese Colonials, 7d.

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YOU CANNOT GET A BETTER BARGAIN THAN

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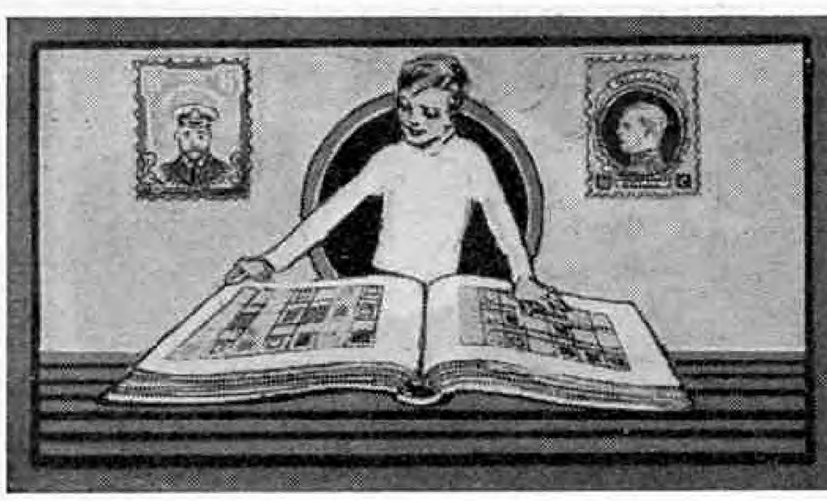


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PACKET. 30 good class **ZOOLOGICAL** stamps only—giraffes, elephants, lions, tigers, birds, etc. **BORNEO** (rhinoceros), **NEWFOUNDLAND** (caribou), **IRAQ** (winged bull). These first three stamps alone are usually sold at nearly **twice** the price I am asking for the packet. **UKRAINE, GUATEMALA, POLAND, VOLTA** (dromedary), **SILESIA, MOZAMBIQUE, SUDAN** (camel), **WALLACE Is.** (bird of paradise), **NYASSA, TCHAD** (leopard), and many other fine stamps, Price **4½d.**

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H. C. WATKINS (M. DEPT.), GRANVILLE ROAD, BARNET



Stamp Collecting

COLUMBUS AND THE DISCOVERY OF AMERICA

IF my readers were asked to name the old-time navigator with whose name they are most familiar, I have no doubt that nine out of ten would answer "Christopher Columbus." He it was who discovered the great American continent and it is with his voyages that we deal in this article.



The stamps we use as illustrations are taken from the Commemorative set issued at the Columbian Exhibition held at Chicago in 1893 to commemorate the discovery of America. The set consisted of 17 issues, the values ranging from 1 cent to 5 dollars. With the exception of the 4 and 5 dollar values, each design depicts some incident in Columbus' career. The two stamps mentioned show portraits of Queen Isabella, to whom reference will be made later, and Columbus himself.

In the scope of this article it is impossible to deal in detail with the famous navigator's life and, as our interest centres mainly around that portion depicted on stamps, we shall concentrate upon the events leading up to and the discovery of America, the greatest achievement of his life.

Christopher Columbus was born in the Italian seaport Genoa, in 1435. As a very small boy he developed a love for the sea, and at the age of 14 he joined his first ship. His cruises took him around the Mediterranean ports, probably on piratical expeditions, for that was the only regular seafaring occupation in those times, and occasionally he ventured as far North as Iceland. There, doubtless, he learnt the story of the exploits of the ancient Vikings, and his imagination was fired.



The crisis of his life came at the age of 35 when, in the course of a fight with a fleet of Venetian galleys, he was wrecked and cast ashore on the coast of Portugal. He settled in Lisbon and during the next few years, in between voyages to Madeira and the Azores, he worked on the details of a project for the discovery of a Western route to the Indies.

Finance was his principal problem. His native Genoa rejected his pleas for the organisation of an expedition. With the King of Portugal he had greater success, but subsequently the King was persuaded by his counsellors to fit out and despatch an expedition unknown to Columbus. This fleet met with disaster, and its survivors returned home to cover their lack of enterprise by ridiculing Columbus' theory. In bitter disgust at the trick that had been played on him, Columbus left the country for Spain and despatched his brother to lay the project before Henry VII, King of England.

In the meantime he endeavoured to interest certain Spanish grandees. The Dukes of Medina took up his case and succeeded in interesting Queen Isabella of Spain. But the time for an expensive project of this nature was inopportune, for Spain had just embarked upon a war with the Moors. Delay after delay occurred until, in 1490, the conference of astronomers appointed three years before to examine the navigator's proposals dubbed the scheme vain and impracticable.



In deep despair—for it was his belief that his was a divine mission—Columbus set out for the coast with the intention of laying his plans before the Court of France. On his journey he called at the Monastery of La Rabida, there to beg bread and water for his son, Diezo, who had accompanied him. By the greatest stroke of fortune that had yet been his, Columbus got into conversation with Juan Perez de Marchena, the Queen's confessor, and Garci Fernandez, a physician, both of whom were keen students of geography. To them he outlined his plans and so deeply were they impressed that Juan Perez determined to use his influence with Queen Isabella to secure further consideration. The scene at one of the discussions in the monastery is shown on the 30c. stamp.



Once more Columbus was summoned to the Court, but sickened by the further buffetings of Court intrigue and jealousy he determined to break off the negotiations and set out for France. His determined attitude swayed the Queen and ere he had travelled ten miles a messenger overtook him and requested an immediate return. The 50c. stamp shows the Queen's messenger delivering the Royal Command. Columbus had gained his object and on 17th April, 1492, an agreement between the King and Queen of Spain and Columbus was signed. Under this Columbus was granted the rank of Admiral, a share in the profits of the expedition and the vice-royalty of all the new lands annexed to the flag of Spain.

Henceforth all was bustle. Within the space of a few weeks the little squadron, consisting of the flagship "*Santa Maria*" and the caravels "*Pinta*" and "*Nina*," was got ready. The "*Santa Maria*" was only 63 ft. in length, 20 ft. in beam, and 10½ ft. in depth. Its displacement was less than 100 tons, while the caravels were even smaller. Each of the ships was built high at the prow and stern, but only the flagship was properly decked amidships. Splendid impressions of the "*Santa Maria*" and of the complete fleet are given on the 3 and 4c. values respectively.

Thus they sailed, with a total strength of 120 souls, on Friday, 3rd August, 1492. Within a few days the "*Pinta*" lost her rudder and nearly a month passed before the fleet got under weigh from Teneriffe, into which port they had put for repairs. Steady progress now was the order, for the weather proved auspicious, but as day succeeded day without a sight of the objective the ship's crews became extremely restive. The curious variations of the compass frightened them, and only by great diplomacy was Columbus able to restrain his men. False alarms of land ahead became frequent, but eventually, on 11th October, the flotsam picked up by the "*Pinta*" gave remarkable promise of an early fulfilment of their dreams. At two in the morning of the following day, the New World was discovered!

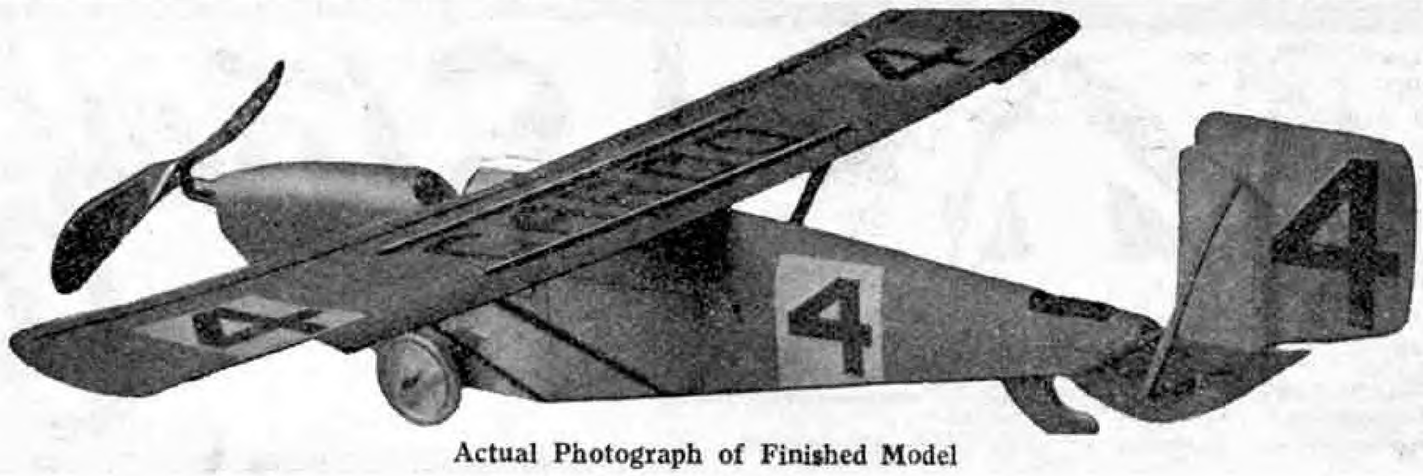
The incident of the sighting of the land, subsequently named San Salvador, and the scene when Columbus stepped ashore, gaily attired in the full dress uniform of his rank and bearing the royal banner of Spain, are shown on the 1 and 2c. stamps.



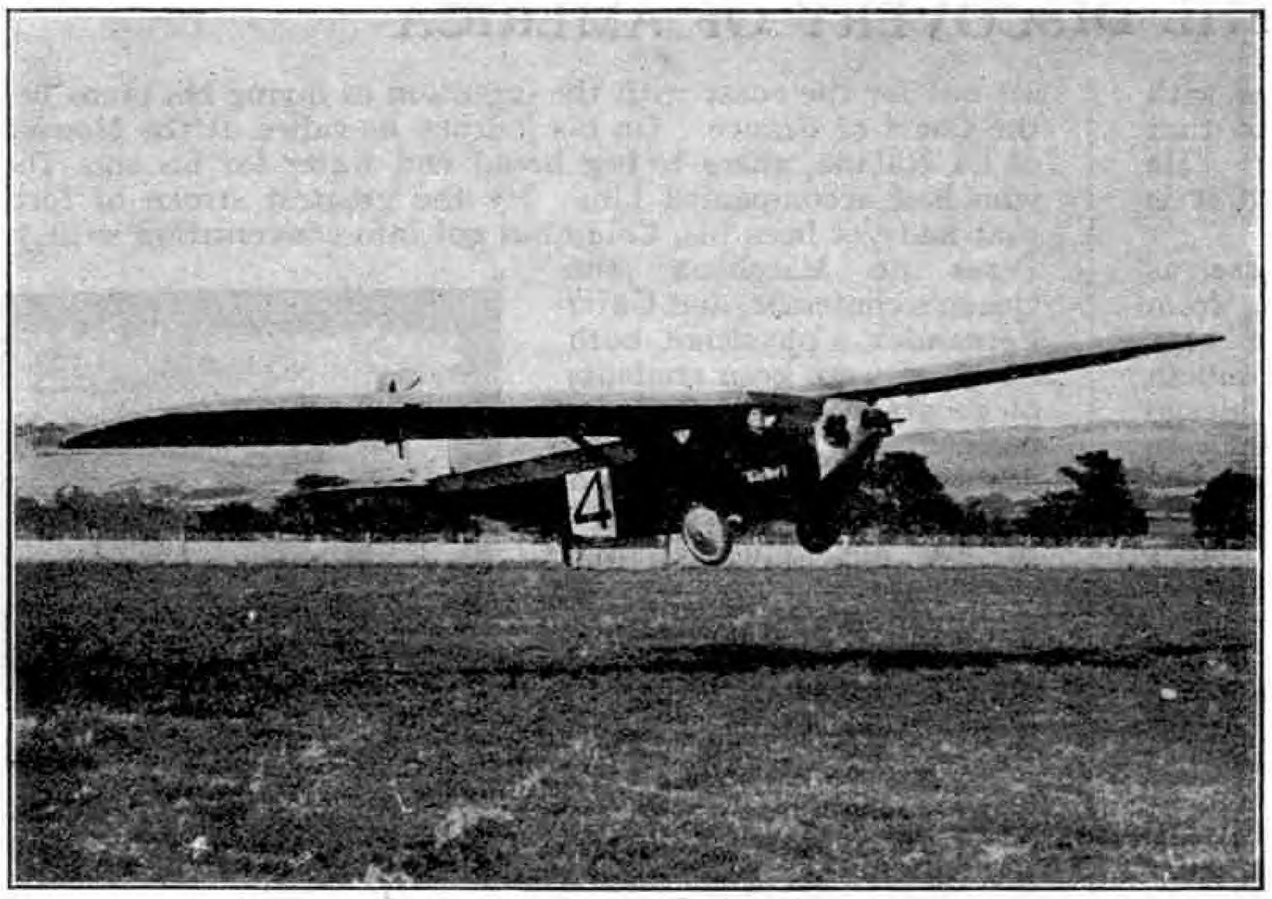
It is impossible to go into the further details of the voyage beyond recording the names of some of the islands

(*Continued on page* 267)

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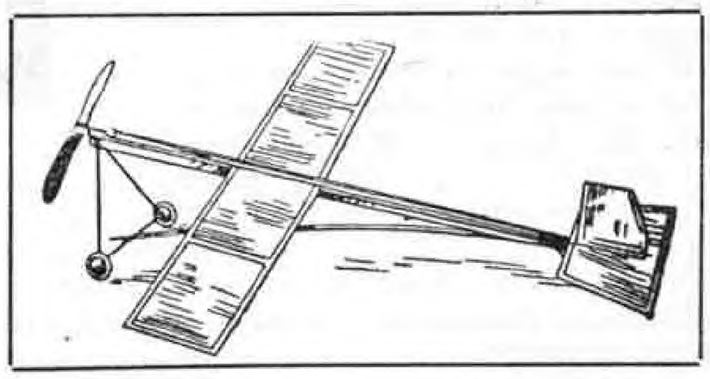
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FREE. 10 British Colonials to genuine approval applicants.—M. Green, 7, Gillhurst Rd., Harborne, Birm.

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BOOKLETS 500 COLONIAL STAMPS from which choose any at ½d. each. Many bargains.—Miss Saunders, 16, Kent Road, East Molesey, Surrey.

FREE MALTA unused (obsolete), or race game. Stamp approvals. — King (BM/BNOK), Monomark House, London.

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150 UNUSED STAMPS FREE to all approval applicants, 100 Danzig or 50 Turkey, 2/-.—H. Stroud, 57, Newbank Road, Blackburn.

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NEW PICTORIAL NEWFOUNDLAND
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Our CASTING MOULDS make thousands from any scrap lead
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Automatic Repeating Action. Heavy Model, Black Finish. Complete with Good Supply of Ammunition. As illustrated. Part postage, 3d. **2/6**
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Stamp Collecting—*(continued from page 265)*

subsequently discovered. Principal among these were Cuba, Haiti (first known as Hispaniola), Santa Maria del Conception, and Isabella. Off Hispaniola the "*Santa Maria*" went aground, and as Columbus was anxious to get home to present his report it was decided to abandon the ship and to build a fort to accommodate the crew until such time as they could be relieved. Setting sail in the "*Nina*" he reached Spain on 4th March, 1493, and immediately set forth for the Court at Barcelona.

His entry into the city was in the nature of a triumphal procession. The scene is taken for the design of the 6c. stamp, while the subsequent presentation of his news before the crowded Court is depicted on the 15c. value. At this audience also he presented nine Indians who were desirous of embracing the Catholic faith, and the presentation is shown on the 10c. stamp.



Columbus now was at his zenith and his requests for further expeditions were granted readily. Unfortunately his success as a navigator was not equalled in his efforts at administration of the new colonies he founded, and, at the end of his third expedition, highly coloured reports of discontent were circulated to discredit him. The result was his immediate recall to Spain under close arrest and in chains! But his heartbroken protests had their effect, and within a few days of reaching Spain he was once more at the Court, not as a prisoner, deprived of his honours, but as a Spanish grandee.

The scene at the accusation and arrest of Columbus is shown on the $2 value, and the presentation of his report on the voyage from which he returned as a prisoner is the theme of the design of the $3 value.

It is doubtful whether the old navigator quite recovered from the indignities forced upon him during his period of arrest but, inspired by his desire to serve the Queen who had done so much for him—Isabella pledged her jewels to help provide funds for the first voyage, an incident that is used for the design of the $1 value—he set off on 9th May, 1502, to discover a Westward passage to Portuguese Asia.

This expedition was ill-starred. Storm followed storm, and his crews were in open rebellion. Wherever he landed quarrels arose with the natives, and at length he was glad to run his ships aground in the little inlet at Don Christopher's Cove, Jamaica. There, racked with sickness and disease, he awaited assistance.

Columbus returned home in 1504, a broken man, far too ill to report at the Court in person, and less than two years later, on 20th May, 1506, he died. His great project, the finding of a Western passage to the Indies, remained incomplete, but in its stead he had accomplished a greater work in the discovery of the great continent we know to-day as America.

We take this opportunity of making acknowledgment to Stanley Gibbons Ltd., for their courtesy in loaning the stamps from which the illustrations used with this article and the Stamp Gossip have been prepared.

Stamp Gossip

Hindenberg's Birthday

To celebrate the birthday of the President, General von Hindenberg, Germany issued a charity stamp bearing the President's portrait toward the end of last year. There were four values, 8, 15, 25 and 50 pfennigs, and each was sold at double price, the extra revenue thus secured being devoted to the relief of distress among poor children.



* * * *

Cyprus

A new pictorial issue in stamps is shortly to be made in Cyprus, and for a time at least the familiar King's head will disappear from the majority of the values. Details of the new stamps are not yet to hand but the values and designs are as follows:—¾ pi, silver coin of Amathus; 1 pi, bust of the philosopher, Zeno; 1½ pi, map of Cyprus; 2½ pi, finding of the remains of St. Barnabas; 4 pi, cloisters of the Abbey of Bella Paise; 6 pi, badge of the Colony; 9 pi, tomb of Umm Haram Larnacha; 18 pi, Richard Coeur de Lion; 45 pi, Church of St. Nicholas, Fana Gusta; £1, His Majesty King George V.

* * * *

Greek Commemoratives

There is now a doubt as to whether the new stamp issue to celebrate the famous battle of the Bay of Navarino will be issued.

The First Stamp Collector

Recently a reader asked us if we could tell him who was the first stamp collector. (No, it was not a catch!) Unfortunately, we could not supply the information with any pretence to accuracy, but we should imagine that the palm must be awarded to the young sweetheart of a London postal official. On receiving a "billet-doux" from her fiancé bearing the first postage stamp ever sold, she was so struck with the novelty of the little label that she decided to paper the walls of her boudoir with them. It is recorded that 16,000 stamps were supplied by friends to aid her purpose, but even then she was obliged to resort to advertising for further supplies in "*The Times.*" Apparently this young lady was not only the first stamp collector, but the first stamp advertiser also!

In 1842 "*Punch,*" commenting on the topic, announced: "A new mania has bitten the industriously idle ladies of England. They betray more anxiety to treasure up the Queen's heads than Henry the Eighth did to get rid of them."

The same reader asked if there is any record of the price at which the unique 1c. British Guiana was first sold. Incredible though it may seem, the original owner, Mr. L. Vernon Vaughan of Demerara, B.G., parted with it for 6/– when he was a boy of 12. Its present owner paid £7,343 for it!



HIS GRACE

A certain member of the peerage owed a considerable sum to a tradesman, who found that the writing of polite reminders produced no results. Accordingly he decided to send his assistant to make a personal call. "And be sure you say 'Your Grace' to him," were his last words before the young man departed on his errand.

In due course the emissary was ushered into the presence of the peer. Holding his cap in his hands, and closing his eyes, the man said, "For what I am about to receive, may I be truly thankful!"

* * * *

Tommy had been absent from school. His mother accordingly wrote a note of explanation. Dear Sir:—Please excuse Tom's absence as he fell down a well, if you will do same you will oblige me,—Yours, Mrs. Jones.

* * * *

A diner had been trying to break up the tough morsel on his plate. "Waiter!" he exclaimed. "What is this?"

"College pudding, sir."

"Ah, one of the foundation stones, I suppose."

* * * *

Stranger: "Boy, where does this road go to?"

Yokel: "Oi doan't think it goes anywhere. It's here every morning."

* * * *

Would-be lodger: "Yes, Mrs. Hash, and I always make it a rule to pay as I go."

The Landlady: "Very good, and remember that my rule is: 'Pay *or* you'll go!'"

* * * *

A Cockney who was on the stage was not given any big part because of his pronunciation. All he had to do was to walk on to the stage, stop in the middle and say "Silence!" and then to walk off the other side. What he actually did was to walk on to the stage, stop in the middle and say "'ush!"

* * * *

Courtier: "Hail, O King."

Pantomime King: "Hush, you chump, that's not my job, I'm here to reign!"

* * * *

The Editor: "What's your excuse for being late, Miss Tappit?"

"I fell downstairs."

"Heavens! That shouldn't have taken long."

* * * *

Waiter: "This is a bad half-crown, sir."

Customer: "I know that—I had a bad dinner!"

* * * *

BITES TO ORDER



An angler who had been endeavouring to hook something for the last six hours was sitting gloomily at his task when two visitors, a mother and her small son, came along.

"Oh," cried out the youngster, "do let me see you catch a fish!"

The mother said, severely, addressing the angler, "Don't you do it! Not until he says 'Please!'"

* * * *

Grandmother: "And do you know why Santa Claus didn't bring you anything, little girl?"

Modern girl: "Yes, I trumped father's ace at whist on Christmas Eve."

STEPPING ON THE GAS

"How are you getting on at school, Alec?"

"Fine! We're learning words of four cylinders now."

* * * *

Teacher: "I have went. That's wrong, isn't it?"
Johnny: "Yes, Ma'am."
Teacher: "Why is it wrong?"
Johnny: "Because you ain't went yet."

* * * *

There was a young lady of Crewe
Who wanted to catch the 2.2;
Said a porter, "Don't hurry,
Or worry or flurry,
It's a minute or 2 2 2 2."

* * * *

An Irish policeman on point duty held up a motorist, saying "Have you a license?"

"Yes," said the man, feeling in his pocket.

"That's all right," interrupted the policeman. "I only wanted to see it if you hadn't one!"

* * * *

GOOD TURNS



Jack: "I'm head over heels in work."
Jim: "What's your job?"
Jack: "Acrobat in a circus."

* * * *

Interviewer: "Aren't you sometimes nervous when you look down at the street below you?"

Steeplejack: "Yes, occasionally. Only yesterday I felt sure I was going to see a pedestrian run over."

* * * *

Manager: "If you were so ill yesterday that you couldn't come to work, Barney, how was it that I saw you passing here on your bicycle?"

Barney: "Shure, sor, that must have been whin Oi was going for the doctor."

* * * *

Woman customer (after salesman had pulled down all but one of the blankets on the shelves): "I don't really want to buy a blanket to-day. I was only looking for a friend."

Clerk: "Well, madam, if you think your friend's hiding in the other one, I'll gladly take it down for you."

* * * *

"WEAK," NOT "WEEK"

During the busy morning hours there appeared at the booking-office window of a large suburban station a young man "all dressed up." He started to discuss with the booking clerk the comparative values of week-end tickets to certain resorts, while the queue behind him were more or less patiently waiting their turn at the ticket window.

As the discussion proceeded the would-be adventurer raised his voice and was heard to say to the clerk: "Well, the fact is, I've got a week-end, and I don't quite know what to do with it." At this juncture a solution was suggested by an exasperated man in the rear of the queue, who shouted, "Put yer 'at on it, sonny!"

* * * *

Pedestrian (in rural district): "Well, we're right off the beaten track now, anyway. No traffic congestion in this neighbourhood!"

Village constable: "Oh, I dunno. Only last week we 'ad a bit of a collision 'ere between old Josh Duggin's bath-chair and the post-mistress' tricycle."

MR. ISAAC'S FINE IDEA

"Good morning, Mr. Isaacs!" remarked the insurance agent. Mr. Isaacs felt alarmed. "Vot's the matter?" he inquired. "My premium's paid, ain't it?"

"Oh, yes; that's all right," said the visitor. "I've merely called to show you these fire extinguishers." Mr. Isaacs laughed. "Fire extinguishers!" he exclaimed. "They're no good to me, my boy. If I'm burnt out, you've get to pay me!"

"Yes, yes, Mr. Isaacs," replied the agent; "but the point is if you keep these extinguishers on your premises, my company allow you 60 per cent. off your premium." "Sixty per cent.!" gasped Isaacs. "Ah, my boy, now you talk business!"

And a moment later Isaacs too, was talking business. So much so, in fact, that when Solomons called at his office next day he found the place literally strewn with bottles. "Vot are you up to, old man?" asked Solomons. "Opening a chemist's shop, eh?"

"No," said Isaacs. Then he explained the nature of his previous day's transaction. "But what do they put in the bottles?" asked Solomons. "Ah," said Isaacs, "I dunno vat was in 'em ven they came, but they're full of petrol now!"

* * * *

"You say your brother blew his brains out with a gun?"

"No, with a saxophone."

* * * *

KEEPING COUNT

The barber was very cheerful and chatty as he lathered his customer's chin.

"No, sir," he said, "I used to give credit, but I don't now. In fact, nobody asks for it now."

"How's that?" asked the customer.

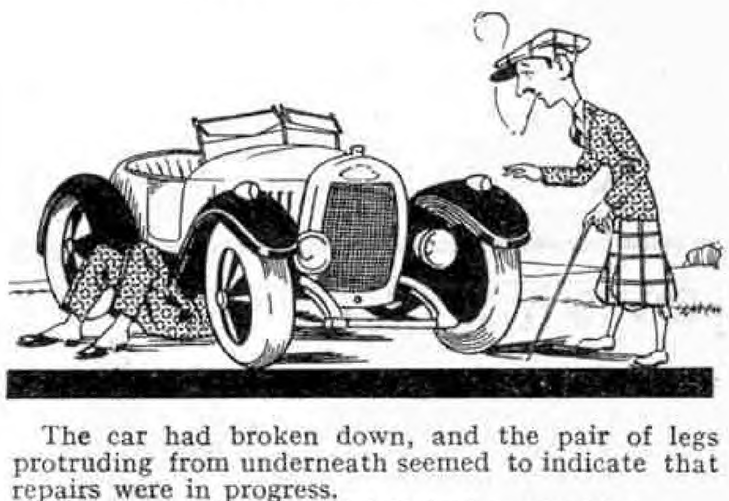
"Well, sir, I once had a set of customers who used to ask me to chalk it up, but they kept me waiting so long that I got tired of keeping books and started a new system. Whenever I shaved one of them I put a little nick in his nose and kept tally that way. It was wonderful how soon they returned to the old plan of paying for each shave at the time."

The customer's voice trembled slightly as his lathered lips moved, and he said:—

"Do you object to being paid in advance?"

* * * *

THE LAST HORSE



The car had broken down, and the pair of legs protruding from underneath seemed to indicate that repairs were in progress.

"Had a breakdown?" inquired a passer-by.

"Oh, no, only playing hide-and-seek with the works," came a muffled voice from underneath the car. But the questioner was not easily daunted.

"What power car is it?"

"Forty horse."

"What's wrong with it?"

"Well, as far as I know," came the answer, "thirty-nine horses have bolted, and the remaining one is too upset to answer questions."

* * * *

Hotel Porter (expecting tip): "Hope you'll have a comfortable journey, sir."

Scot: "Verra sorry, laddie, but I've gien ma sma' change to the chamber maid."

Hotel Porter: "She told me you didn't give her anything."

Scot: "A-weel, if I did'na' gie yon bonnie lassie onything, what sort of a chance do ye think you've got?"

WHAT HE'D GET

An inspector was examining an elementary school at the beginning of the year. He asked a little girl: "If I lend your father one hundred pounds, and he promises to repay me ten pounds every month from the 1st of March, how much will he owe me on the 31st of December?"

The little girl hesitated a second and then replied: "One hundred pounds."

"My dear child," said the inspector, "you do not know the rudiments of arithmetic!"

"Oh, yes, I do, sir!" she replied, "But you do not know my father!"

* * * *

Tramp: "Old lady, spare a copper for a poor man."
Lady: "How dare you say I am old!"
Tramp: "If you were crossing the road and saw a worm, would you pick it up?"
Lady: "Certainly not!"
Tramp: "Well, you are not a chicken!"

* * * *

Old Gentleman: "Remember, my man, hard work is the thing. Begin at the bottom and work up."

Pat: "It can't be done in my business, Sir, I'm a well digger!"

* * * *

John: "Professor Smith has given me a ticket for a lecture and I don't quite know what he means by it."
Charles: "Why, what is the trouble?"
John: "The lecture is on 'Fools,' and on the ticket it says 'Admit one!'"

* * * *

A Cockney was showing an American friend round London, but without arousing much enthusiasm.

"What do you think of that?" he asked.

"Waal," drawled the American, "it's not a bad sized building, but there's only one. I guess there's hundreds like that in New York. But what is it?"

"A lunatic asylum!"

* * * *

"Now Minnie, how many more times have I to tell you about those cobwebs? I've just had to sweep one off the bed-rails and put it in the fire myself!"

"Good lawd, sir! That's the missus's fancy dress for to-night's ball!"

* * * *

Inspector: "That new man will never make a detective."
Chief: "How is that?"
Inspector: "There was a cwt. box of soap stolen from a railway van and the fool arrested a tramp."

* * * *

A business man was visiting Chicago and decided to buy a new hat. Going into a shop, he asked the price of one that looked good to him. The assistant replied "Fifteen dollars."

"Where are the holes?" the business man asked, examining the hat critically.

The assistant appeared bewildered for a moment, but managed to ask, "What holes?"

"Why, the holes for the ears of the ass that would pay fifteen dollars for a hat like that."

* * * *

MORE MOTORING EPITAPHS

James Johnson occupies this bunk;
He tried to drive while he was drunk.

Close by the brook sleeps Ernest Bass;
The bridge was narrow; he tried to pass.

Here reposes John H. Kidd,
Who thought he wouldn't skid, but did.

Here lie the bodies of both the Drakes;
They trusted too much in their 4-wheel brakes.

Heaven help women like Martha Marr;
She took one lesson, then drove her own car.

O'er Mike O'Toole they've now said Mass;
He reached for his brake but stepped on the gas.

Here lie the remains of Percival Sapp;
He drove a car with a girl on his lap.

Slumbering here is William Blake;
He heard the bell, but had no brake.

Beneath this stone lies Henry Baines;
Ice on the hill, he had no chains.

Here's Mary Jones, but not alive;
She made her car do sixty-five.

Ed. Smith is lost to earthly wiles;
He took a curve at fifty miles.

Beneath this turf lies Arthur Meek;
He used a match on a gas tank leak.

NAMES AND DEEDS

"And what are you going to call him?" asked the doctor of the happy father.

"Reginald D'Arcy, sir."

"That's rather an uncommon name for the East End of London, isn't it?"

"Yes, sir. But I want him to be a boxer."

"I don't quite see the connection," replied the somewhat mystified medico.

"Oh, that's easy sir. Look at the practice he will get at school with a name like that!"

* * * *

An irate mother had her son by the ear and held a menacing cane. "I'll learn ye to tie a kettle to the cat's tail!" she exclaimed wrathfully.

"But, it wasn't our cat," rejoined the boy.

"No, it wasn't our cat," said the enraged mother, "but it was our kettle!"

* * * *

Warder: "What! You back again!"
Convict: "Yes. Any letters or parcels for me?"



WHY HEAD OFFICE CLERKS GO BALD.

Courtesy] [*L.N.E.R. Magazine*

A small boy was told that when visitors came to the house it was his duty to pay them some attention.

Shortly afterwards a Mrs. Daniel called, and the small boy shook hands with her politely and exclaimed in his best drawing-room manner:—

"How do you do, Mrs. Daniel? I've just been reading about your husband in the den of lions!"

* * * *

TOO PERSISTENT

He was from the remote Highlands, on his first visit to London. On arriving at Euston a voice immediately said, "Taxi, sir?"

Donald shook his head.

After exploring London our Scots friend proceeded to Bristol. On emerging from the station he heard the familiar hail, "Taxi, sir?"

The Scot became annoyed. "No thank ye," he bawled. "I said 'No' in London and I meant it. Now stop following me."

* * * *

Chauffeur (applying for job, to doctor): "I was last with Dr. Banks, and I may say, sir, that in the course o' my duties I was the means o' providin' 'im with quite a lot o' patients."—*The Humorist.*

* * *

Jones turned on his wireless set and found he had cut in on the weekly health talk from his local station. He heard:—

"And all medical authorities recommend Dr. Curem's formula for ailments of the heart, lungs, stomach, liver, kidneys, intestines, pancreas, gall, bladder, thyroid gland, oesophagus, and vermiform appendix."

"My word!" cried Jones. "An organ recital!"

LONG AND SHORT OF IT

In Kent, there is a farmer who was born with one of his legs longer than the other, and he is very touchy concerning his legs. A gentleman who was on a tour stopped and had a talk with the farmer, and he said:

"How did it happen that you have a short and a long leg? Did you meet with an accident?"

"No, sir. It wasn't an accident, they were made at my request."

"Ha, ha, that's funny; tell me about it."

"I wanted to be a farmer from the very day I was born. That right leg—the longest one—when I'm ploughing can go into the furrow, and the short one, on the top, without bobbing up and down, as one of you City folks would do. See?"

* * * *

"This is the fourth anonymous letter I've received.
"Do as I do—tear them up without opening them."

* * * *

"What did mama's little baby learn at school to-day?"

"I learned two kids not to call me 'mam's baby.'"

* * * *

Bald-headed Man: "You say this is a good hair tonic?"

Drug Clerk: "Very fine; we have a clean-shaven customer who took the cork out of the bottle with his teeth and next day he had a moustache!"

* * * *

Rastus: "Dat baby of yours am de perfect image of his daddy."

Rasta: "He suah am. He am a reg'lar carbon copy."

* * * *

An ardent angler took a friend fishing. He knew nothing about the gentle art, but was set up with the necessary tackle and a nice, comfortable seat on the bank. The experienced hand started fishing a few yards higher up the stream. Presently the novice said, "How much do those red things cost?"

"I suppose you mean the float," said the angler. "They cost only about sixpence."

"Well, I owe you sixpence," said the novice. "The one you have lent me has sunk!"

* * * *

A Japanese gentleman studying railway working methods in this country amused one of the female clerks in a certain office a good deal by saying whenever he left her that he would "cockroach" no more upon her time. When they had got to know each other fairly well she thought the time had come to explain to him the nature of his little mistake.

"You should not say 'cockroach on your time,' but encroach," she remarked sweetly.

"Oh, I see," replied the Japanese gentleman, his face lighting up with intelligence, "'cockroach' if it is a gentleman you are saying good-bye to, and 'encroach' if it is a lady!"
—*Southern Railway Magazine.*

* * * *

Teacher: "Name three things that contain starch."

Pupil: "Two cuffs and a collar, sir."

* * * *

John: "Look how high that ship is floating out of the water."

Mary: "Oh, didn't you know, dear, it's low tide just now?"

* * * *

IT WAS NO PROOF

"Sambo, whar you get dat watch you wear to meetin' last Sunday?"

"How you know I hab a watch?"

"Bekase I seed de chain hang out de pocket in front."

"Go 'way, nigger! S'pose you see halter round my neck, you t'ink dar is horse inside ob me?"

* * * *

Guide: "These are the ruins of a castle of the earliest invaders."

Tourist: "Why did they build it so far away from the station?"

* * * *

"How far is it to the station, my boy?" asked the stranger.

"It's about twenty minutes' walk," replied the boy, "if you run."

* * * *

A foreigner was rushing wildly down the street when he was suddenly grabbed by a policeman. "Here, you mustn't go racing about like that," said the latter. "What's your name?"

"Je ne comprends pas," gasped the foreigner, as he tried to wriggle himself free from the constable's grasp. "Je ne comprends pas!"

"Here, hold on," said the policeman, pulling out his notebook. "How d'ye spell it?"

BRITISH AND GUARANTEED

ROLLING STOCK

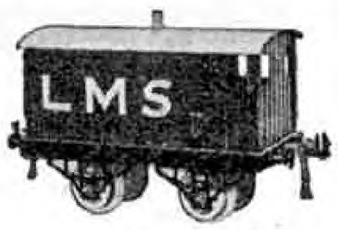
Gauge 0 Hornby Series Gauge 0

SEND FOR COMPLETE ILLUSTRATED LIST

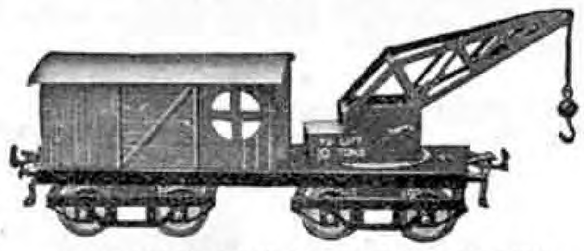
Below we illustrate 35 pieces of Rolling Stock of various types. These form part of the big range of components included in the Hornby Series. All Hornby Rolling Stock is modelled on realistic lines and is beautifully finished in colours. Each piece is available with either L.M.S., L.N.E.R. or G.W. lettering. Ask your dealer to show you the full range.



***HORNBY WAGON**
As supplied with all Hornby Goods Sets.
Price **2/6**



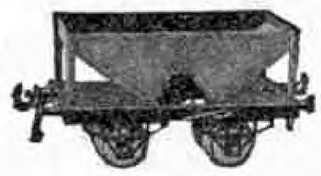
***BRAKE VAN**
Finished in grey, with opening doors. Price **3/6**



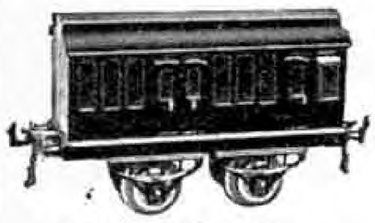
***BREAKDOWN VAN AND CRANE**
Beautifully coloured in grey and black, with opening doors. Suitable for 2-ft. radius rails only ... ... Price **6/3**



***BRAKE VAN**
Finished in grey, with opening doors. Price **3/6**



***HOPPER WAGON**
Mechanically unloaded. Finished in grey and black ... Price **4/-**



***GUARD'S VAN**
Realistic design, fitted each side with opening doors. Price **3/6**



WAGON
French type. Lettered Nord. Highly finished in colours.
Price **3/3**



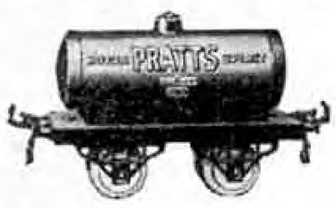
***No. 2 LUMBER WAGON**
Fitted with bolsters and stanchions for log transport. Suitable for 2-ft. radius rails only.
Price **4/-**



MOTOR SPIRIT TANK WAGON, "B.P."
Finished in Yellow.
Price **2/6**



***HORNBY PASSENGER COACH**
As supplied with No. 0 and No. 1 Passenger Sets and No. 2 Tank Passenger Sets.
Price **3/6**



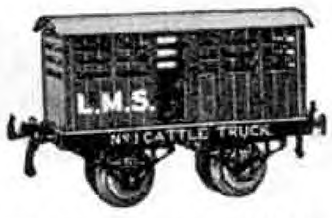
PETROL TANK WAGON "PRATTS"
Finished in green. Price **2/6**



***MILK TRAFFIC VAN**
Fitted with sliding door, complete with milk cans.
Price **3/6**



***No. 2 LUGGAGE VAN**
Finished in blue and green. Fitted with double doors. Suitable for 2-ft. radius rails only ... Price **5/9**



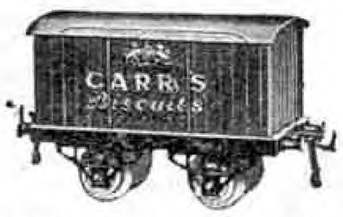
***No. 1 CATTLE TRUCK**
Fitted with sliding door. Very realistic design.
Price **3/6**



PETROL TANK WAGON "SHELL"
Finished in red. Price **2/6**



JACOB'S BISCUIT VAN
Finished in crimson lake, with opening doors.
Price **3/6**



CARR'S BISCUIT VAN
Finished in dark blue, with opening doors.
Price **3/6**



***No. 2 TIMBER WAGON**
Beautifully enamelled in green. Suitable for 2-ft. radius rails only ... ... Price **3/6**



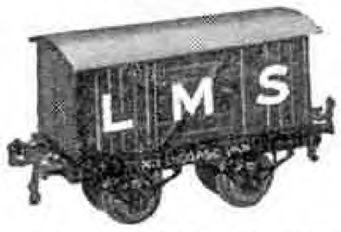
SECCOTINE WAGON
Beautifully finished in blue, with opening doors.
Price **4/-**



CRAWFORD'S BISCUIT VAN
Finished in red, with opening doors. Price **3/6**



***CRANE TRUCK**
Finished in grey and black ... Price **3/6**



***No. 1 LUGGAGE VAN**
With opening doors.
Price **3/6**



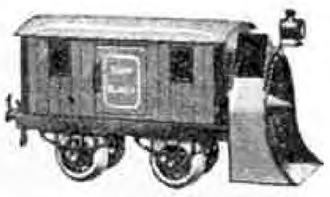
***No. 2 CATTLE TRUCK**
Splendid model fitted with double doors. Suitable for 2-ft. radius rails only ... ... Price **5/9**



***GUNPOWDER VAN**
Finished in red, with opening doors. Price **3/9**



***GAS CYLINDER WAGON**
Finished in red, lettered gold. Price **2/6**



***SNOW PLOUGH**
With revolving plough driven from front axle.
Price **5/6**



***No. 1 LUMBER WAGON**
Fitted with bolsters and stanchions for log transport.
Price **2/-**



***TROLLEY WAGON**
Finished in grey and red. Suitable for 2-ft. radius rails only ... Price **5/6**



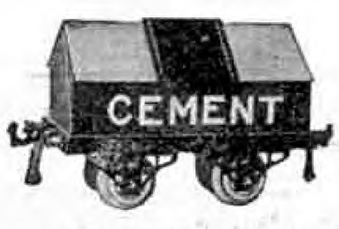
No. 1 TIMBER WAGON
Beautifully enamelled in green. Price **1/9**



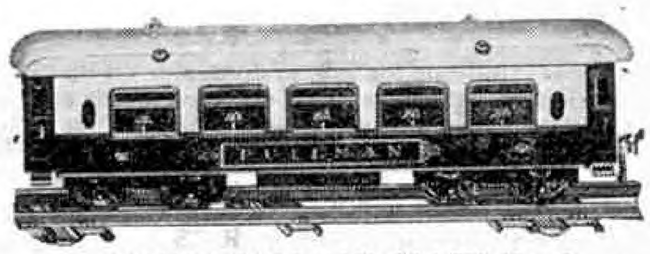
BRAKE VAN
French Type. Lettered Nord. Beautifully finished in colours. Opening doors.
Price **4/-**



SIDE TIPPING WAGON
Excellent design and finish.
Price **2/6**



***CEMENT WAGON**
Finished in grey and black. Price **3/-**



HORNBY PULLMAN COACH No. 3
As supplied with No. 3 Train Sets
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Enamelled in white, with opening doors. Price **3/9**



ROTARY TIPPING WAGON
Finished in grey and green.
Price **3/-**

Lettered L.M.S., L.N.E.R. or G.W.

Manufactured by MECCANO LIMITED, BINNS ROAD, LIVERPOOL

STATIONS AND ACCESSORIES

Hornby Series

The Hornby System consists of a comprehensive range of Stations, Platforms and Accessories with which the most elaborate model Railway Terminus or Goods Yard may be constructed. Every item is exceptionally well designed and is carefully modelled on its prototype in real life. A selection of the various components included in the Hornby Series of Stations and Accessories is illustrated below.



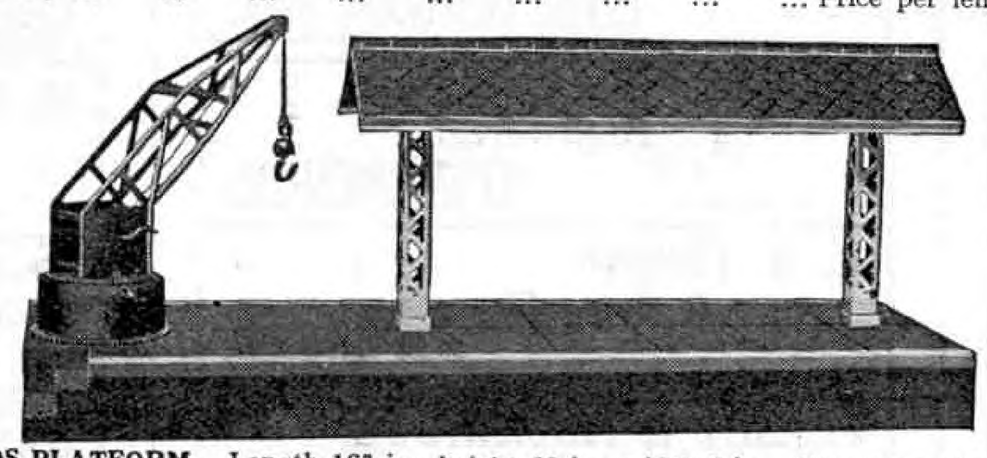
RAILWAY STATION. Excellent model, beautifully designed and finished. Constructed in three sections which are detachable. Dimensions: Length 2-ft. 9-in., breadth 6-in., height 7-in. ... ... Price **10/-**

PASSENGER PLATFORM. Length 16¾-in., width 3-in. This platform may be connected to the main station or used separately. The interlocking device at each end enables a number of these platforms to be joined together ... ... Price **3/6**

White paled fencing as supplied with the Passenger Platform may also be purchased separately ... ... Price per length **6d.**



SIGNAL CABIN
Dimensions: Height 6½-in., Width 3½-in., Length 6½-in. Finished in colours and lettered "Windsor." Roof and back open to allow a signal lever frame to be fitted inside cabin, if desired, and operated ... Price **6/6**



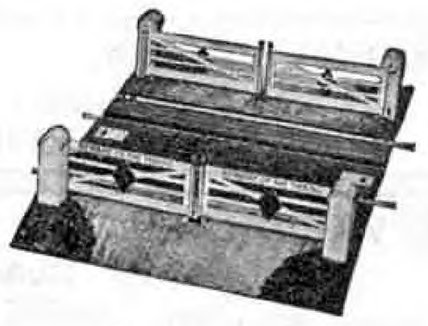
GOODS PLATFORM. Length 16¾-in., height 6¾-in., width 6-in. The crane at the end of the platform revolves on its base. It is enamelled in bright red and is fitted with a crank and ratchet mechanism for controlling the load. The remainder of the platform and shelter is coloured in green, blue and white ... ... Price **10/-**

ISLAND PLATFORM. Length 32½-in., height 6¾-in., width 3-in. The ramps at either end are detachable, and if desired the platform may be connected to the main station. Attractively coloured in green, blue and white ... ... Price **7/6**

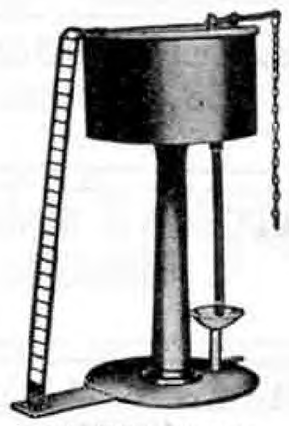
Ramps similar to those fitted to the Island Platform may be purchased separately. Price **9d.** each.



TELEGRAPH POLE
Price per pair **3/6**



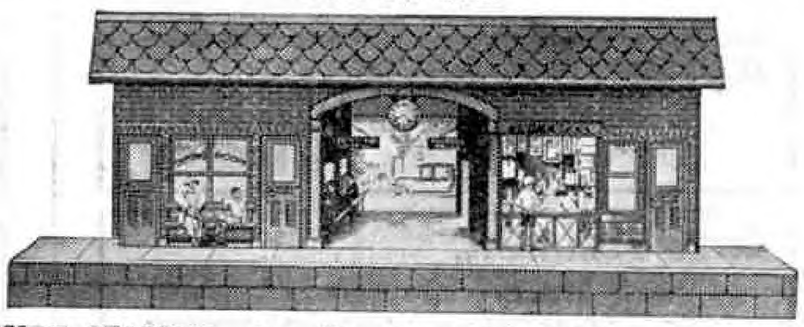
LEVEL CROSSING
Beautifully designed in colours. Measures 11½ × 7¼-in. with Gauge 0 rails in position. Price **5/-**



WATER TANK
Brightly coloured. Stands 8½-in. high. Fitted with flexible tube and valve lever. Price **6/6**



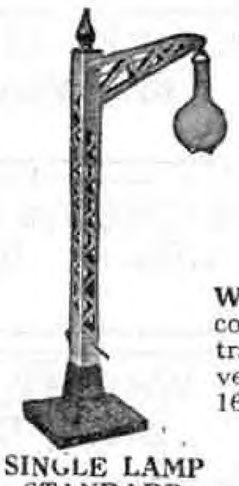
LOADING GAUGE
Price **1/9**



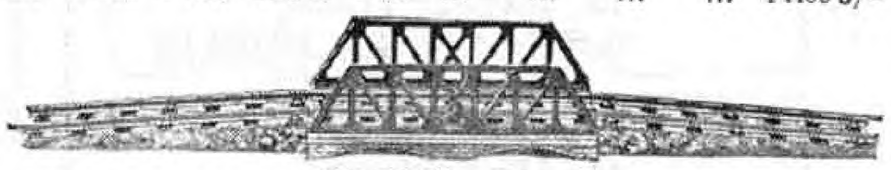
WAYSIDE STATION. A well-made model, richly finished in bright colours. By placing one or more of these Stations at intervals along the track, and using the Windsor Railway Station as the main terminus, a very realistic effect is given to a miniature lay-out. Dimensions: Length 16¾-in., width 6-in., height 9-in. ... ... Price **5/-**



TURN-TABLE
Large Size ... Price **4/-**
Small Size ... ,, **2/6**



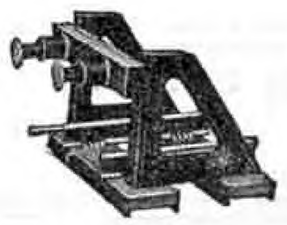
SINGLE LAMP STANDARD
A 4-volt bulb may be fitted into the globe. Price **3/-**



VIADUCT. Price **7/-**
ELECTRICAL VIADUCT. Price **8/-**
Centre Section for Viaduct. Price **4/6**
Centre Section for Electrical Viaduct. Price **5/-**



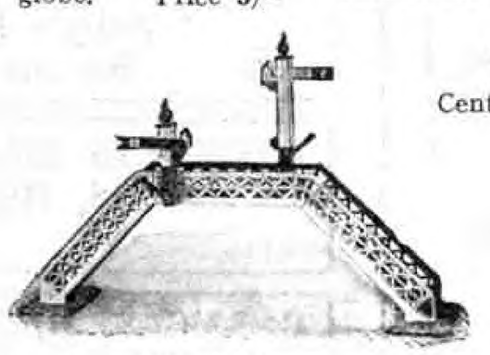
SIGNAL
"Home" or "Distant."
Price **2/6**



SPRING BUFFER STOPS
Price **1/-**



DOUBLE LAMP STANDARD
Four-volt bulbs may be fitted into the globes.
Price **4/-**



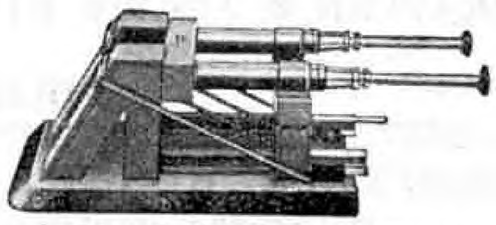
FOOTBRIDGE
No. 1. With detachable Signals Price **6/-**
No. 2. Without Signals ... ,, **3/6**
Signals only ... ... per pair **2/9**



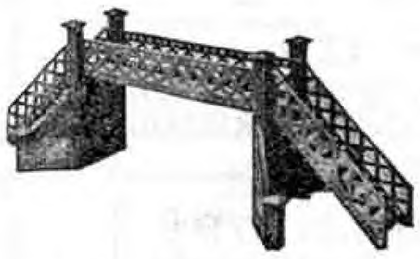
PLATFORM ACCESSORIES
No. 1. Miniature Luggage.
Price per set **1/6**



PLATFORM ACCESSORIES
No. 3. Platform Machines, etc. Price per set **1/6**



HYDRAULIC BUFFER STOPS
Price **5/-**



LATTICE GIRDER BRIDGE
Constructional type. Strong and well proportioned.
Price **9/6**



PLATFORM ACCESSORIES
No. 2. Milk Cans and Truck.
Price per set **1/6**



JUNCTION SIGNAL
Signal arms operated by levers at base. Very realistic model standing 14-in. in height.
Price **5/6**

Meccano & Hornby Train Supplies

All the dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

HARRY BROWN,
1, Moss Lane,
ALTRINCHAM.

J. WOODHALL,
256, Grange Road,
'Phone : B'head 621 **BIRKENHEAD.**

HOBBIES LTD.,
9a, High Street,
BIRMINGHAM.

MERCER'S DOLLS' HOSPITAL,
68, Darwen Street,
BLACKBURN.

BATESON'S SPORTS DEPOT,
Abingdon Street,
BLACKPOOL.

SELLEN'S BAZAAR,
54, Waterloo Road,
BLACKPOOL, S.S.

J. MORRIS, F.C.O.,
70, Knowsley Street,
Tel. 1074 **BOLTON.**

BROWN, MUFF & CO. LTD.,
BRADFORD.

HOBBIES LTD.,
68, London Road,
BRIGHTON.

JOHN TAYLOR,
28, Preston Street,
Tel. : Brighton 957 **BRIGHTON.**

BRISTOL TOY EXCHANGE,
92b, Whiteladies Road,
Clifton, BRISTOL.

GYLES BROS. LTD.,
Tel. 2888 **24, Bridge Street, BRISTOL.**
188, Whiteladies Road, Clifton, BRISTOL.
Tel. 143

JOHN HALL (TOOLS) LTD.,
BRISTOL. NEWPORT.
CARDIFF. SWANSEA.

SALANSON LTD.,
20, High Street, BRISTOL.
4, High Street, CARDIFF.

SAM TAYLOR,
Silver Street,
Tel. 320 **BURY.**

HAROLD HUNT,
38, Spring Gardens,
Tel. 202 **BUXTON.**

HOBBIES LTD.,
385½, Yonge Street, Toronto 2,
CANADA.

H. W. GILL,
23 & 24, Pittville Street,
CHELTENHAM SPA.

THOMAS JAMES & SON,
High Street,
CINDERFORD.

R. H. JEPSON,
1, Cross Cheaping,
COVENTRY.

PURSEY & MOCKRIDGE,
The Sports Outfitters,
Tel. Dartford 173 **DARTFORD.**

HENRY WHALLEY,
195, Duckworth Street,
DARWEN.

RATCLIFFES TOYERIES,
19, Osmaston Road,
DERBY.

C. E. MELLER,
"Dolls' Hospital,"
55, Hall Gate, DONCASTER.

JAMES L. DIXON,
14, Suffolk Street,
(off Grafton St.), DUBLIN.

DIXON'S,
41, High Street,
DUNDEE.

DRAFFEN & JARVIE LTD.,
Nethergate,
DUNDEE.

BASSETT-LOWKE LTD.,
5, Frederick Street,
EDINBURGH.

ROBERT BALLANTINE,
103½, St. Vincent Street,
GLASGOW.

CLYDE MODEL DOCKYARD,
22-23, Argyll Arcade, GLASGOW.
Model Makers to the Admiralty, the Railway Coys., etc.

HOBBIES LTD.,
326, Argyle Street,
GLASGOW.

The MARVEL MART (Wm. Ross & Co.)
110, West Nile Street,
GLASGOW.

FLETCHER'S TOYLAND,
77, Deardengate, HASLINGDEN.
Grand Building, RAWTENSTALL.

H. POULTON, Toyland,
75 & 77, High Street,
HOUNSLOW, Middlesex.

GAMLEYS,
The Hove Hornby Train Store,
78, Church Road, HOVE.

HAMMOND'S LTD.,
Paragon Square,
HULL.

W. J. S. CARPENTER,
13 & 15, Queen Victoria Street,
LEEDS.

HOBBIES LTD.,
89a, Woodhouse Lane,
LEEDS.

PEARSON & DENHAM (PHOTO) LTD., 6, Bond Street,
LEEDS.

A. WRIGHT, The Garage,
200/2, Dewsbury Road,
Tel. 22719 **LEEDS.**

ROBOTHAM'S LIMITED,
"Baby's Kingdom,"
Tel. 4809 **Belvoir St., LEICESTER.**

BYCROFTS EMPORIUM,
366, High Street,
LINCOLN.

C. LUCAS, Hobbies Depôt,
35, Manchester Street,
LIVERPOOL.

Reliance Cycle & Motor Co.,
29/31, Manchester St., Liverpool.
Argyle & Conway Sts., Birkenhead.

DEMPSEY & CO.,
69, South Side, CLAPHAM,
'Phone : Brixton 3022 **LONDON, S.W.4.**

Meccano & Hornby Train Supplies

The thirty-three dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

The ARUNDEL CYCLE & SPORTS STORE, 52, Church Road, Upper Norwood, LONDON, S.E.19.

HOBBIES LTD., 65, New Oxford Street, Tel. Mus. 1656 LONDON, W.C.

HOBBIES LTD., 147, Bishopsgate, Tel. London Wall 7350 LONDON, E.C.

HOBBIES LTD., 79, Walworth Road, Tel. Central 2457 LONDON, S.E.

W. HUMPHRYS & SON, 269/271, Rye Lane, Estab. in 1840 PECKHAM, S.E.15.

LEDWITH BROS., 42 & 44, Walworth Road, Nr. ELEPHANT AND CASTLE, LONDON, S.E.17.

F. R. POTTER & SON, 43, Market Place, LOUGHBOROUGH.

H. G. PARTRIDGE & CO., 10, Chapel Street, Tel. 234 LUTON.

BARRS, Children's Paradise, 49, Deansgate, Telephone 165 City. MANCHESTER.

A. FRANKS LTD., 95 & 97, Deansgate, MANCHESTER. 90, Bradshawgate, BOLTON.

HENRY'S Toy & Game Stores, 22, King Street, Tel. 3004 Central MANCHESTER.

HOBBIES LTD., 10a, Piccadilly, MANCHESTER.

A. INMAN, MANCHESTER. 105, Lapwing Lane, Didsbury. Tel. 1518. 179, Dickenson Rd., Rusholme. Tel. 2241.

JOHN NESBITT LTD., 42, Market Street, MANCHESTER.

H. WILES LTD., 124, Market Street, MANCHESTER.

R. SCUPHAM & SONS, 35, Linthorpe Road, MIDDLESBROUGH.

WILLIAM OLLIFF, 13, Grainger Street West, NEWCASTLE-ON-TYNE.

BEECROFT & SONS, Exchange Corner, Market Place, NOTTINGHAM.

J. R. NORRIS, Photographic Dealer, 9, Pelham Street, NOTTINGHAM.

JANES & ADAMS, 13, The Promenade, And Branches. PALMERS GREEN.

DEAN & HOLT, 78, Yorkshire Street, ROCHDALE.

A. E. HAIG, 16, Northenden Road, SALE, CHESHIRE.

HOBBIES LTD., 214, West Street, SHEFFIELD.

THE REDGATE CO. (SHEFFIELD) LTD., Tel. 22806 Moorhead, SHEFFIELD.

SHEFFIELD PHOTO COMPANY, 6, Norfolk Row (Fargate), 'Phone 23891 SHEFFIELD.

WILSON, GUMPERT & CO. LTD., 57, Fargate, Tel. 20489 SHEFFIELD.

BIRMINGHAM & COVENTRY CYCLE CO., 140 & 151, Above Bar, SOUTHAMPTON.

HOBBIES LTD., 25, Bernard Street, SOUTHAMPTON.

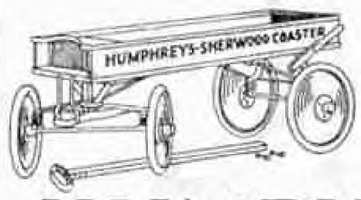
OSBORN & CO., 9, High Street, SOUTHAMPTON.

S. T. SIMPSON & SON, 589-595, Lord Street, Tel. 4998 SOUTHPORT.

H. W. GINN, The London Motor, Cycle & Sports Co., Tel. 252 Staines 106, High St., STAINES.

E. M. COLLINS, 12, Lower Castle Street, TRALEE.

SPORTS HOUSE WOKING & WEYBRIDGE.



42'6 CARRIAGE PAID

HUMPHREYS

Sherwood Coaster

WILL CARRY A TON

Disc Wheels. Roller Bearings. Solid Rubber Tyres. Coil Spring Shock Absorbers.

Write for illustrated list.

HUMPHREYS,

Meccano and Hornby Train Depot, Next Grove Arcade,

WALLASEY VILLAGE CHESHIRE

HOME CINEMATOGRAPHS



Machines from 5/- to £16. Lighting Sets, Rewinders, Spools and all accessories. Films all lengths and subjects. Sample Film 1/- post free. *Illustrated Price Lists Free. Agents for "Campro" Cine Camera-Projector.*

Call or Write **FORD'S (Dept. M), 13, Red Lion Sq., London, W.C.1** (Entrance Dane St.)

MAKE YOUR OWN ELECTRIC LIGHT

These wonderful Dynamos light brilliantly 4-6v. lamps, and are very easy to work. **5/6**, post 6d. Delivery by return of post.



5/6

GREENS (Dept. E.N.), 14, New Oxford Street, London.

MAKE OR BUY A GRAMOPHONE 100% cheaper than others. Mechanical Parts of a 1st-class **RIFANCO-Phone:** Double Spring Motor, 12-in. Turntable, Swan or "S" Tone-arm, Superior Sound Box, Internal Horn or Cast Throat Needle Cup as fitted by other firms in £10, £20 Gramophones. All bar the wood. **Nett Cash £1:18:6**

This set supplied with polished Oak or Mahogany 40 in. high Cabinet as shown, or Jacobean Pedestal. **Nett Cash £4:10:0**

Carriage paid in U.K.

Other sets from 18/-. Machines 30 models, Sideboards, Pedestals, Portables, etc., from 19/6. Motors 9/-. New 1928 216-page Catalogue of Accessories with Instructions *How to make Gramophones* 3d. Established 24 years.

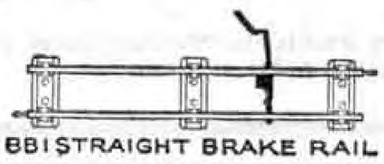


1,000 Testimonials

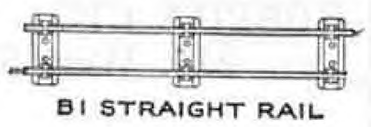
Regent Fittings Co., 78D, 120, Old St., London, E.C.1

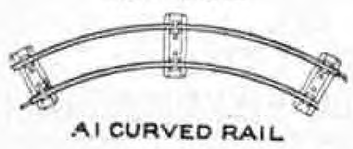
HORNBY Rails Points and Crossings SERIES

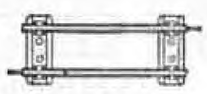

A1¼ CURVED QUARTER RAIL

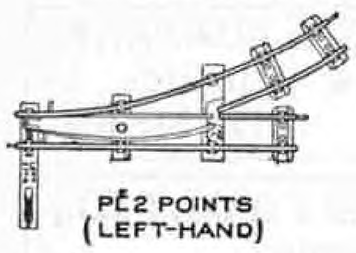

BB1 STRAIGHT BRAKE RAIL

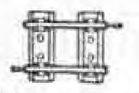

A1½ CURVED HALF RAIL

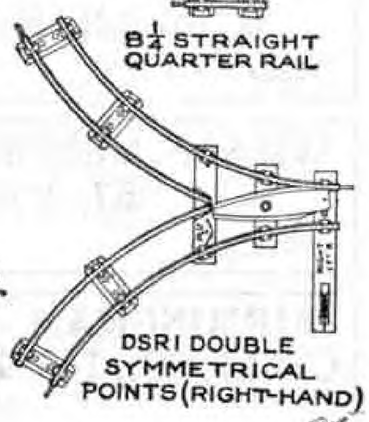

B1 STRAIGHT RAIL

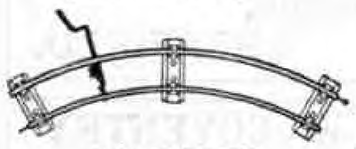

A1 CURVED RAIL

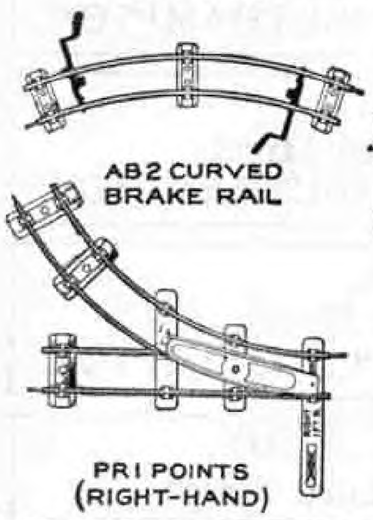

B½ STRAIGHT HALF RAIL

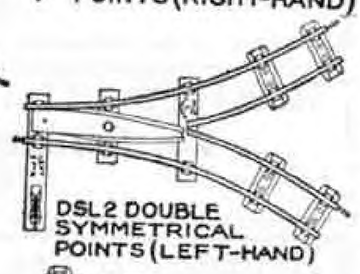

PE2 POINTS (LEFT-HAND)


B¼ STRAIGHT QUARTER RAIL

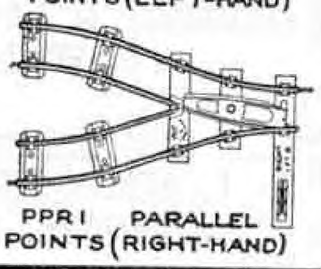

DSR1 DOUBLE SYMMETRICAL POINTS (RIGHT-HAND)


AB1 CURVED BRAKE RAIL


AB2 CURVED BRAKE RAIL


DSL2 DOUBLE SYMMETRICAL POINTS (LEFT-HAND)

PR1 POINTS (RIGHT-HAND)


PPR1 PARALLEL POINTS (RIGHT-HAND)

Hornby Rails, Points and Crossings are designed to meet the most exacting requirements of model railway enthusiasts. They make possible an almost endless number of realistic and railway-like layouts. Only the finest materials obtainable are used in their manufacture.

For Clockwork & Steam Trains

CURVED RAILS. For 2-ft. diameter circle.

A1	Curved rails (1-ft. radius)	... per doz.	4/6
A1½	Curved half rails	„ ... ... „	3/6
A1¼	Curved quarter rails	„ ... ... „	3/–
AB1	Curved brake rails	„ ... ... each	6d.

CURVED RAILS. For 4-ft. diameter circle.

A2	Curved rails (2-ft. radius)	... per doz.	4/6
A2½	Curved half rails	„ ... ... „	3/6
A2¼	Curved quarter rails	„ ... ... „	3/–
AB2	Curved brake rails	„ ... ... each	6d.

STRAIGHT RAILS.

B1	Straight rails	... per doz.	4/–
B½	Straight half rails	... ... „	3/–
B¼	Straight quarter rails	... ... „	2/6
BB1	Straight brake rails	... ... each	5d.
BBR1	Straight brake and reverse rails		„ 1/6

CROSSINGS AND CROSSOVERS.

CA1	Acute angle crossings (1-ft.)	... each	1/6
CA2	Acute angle crossings (2-ft.)	... „	1/6
CR1	Right-angle crossings (1-ft.)	...	1/6
CR2	Right-angle crossings (2-ft.)	... „	1/6
CO1	Crossover (1-ft. radius)	... „	6/6
CO2	Crossover (2-ft. radius)	... „	7/6

POINTS. For 1-ft. radius curves.

PR1	Right-hand points	... }	per pair 4/–
PL1	Left-hand points	... }	

POINTS. For 2-ft. radius curves.

PR2	Right-hand points	... }	per pair 4/–
PL2	Left-hand points	... }	

DOUBLE SYMMETRICAL POINTS. For 1-ft. radius curves.

DSR1	Double symmetrical points, right	}	per pair 5/–
DSL1	Double symmetrical points, left	}	

For 2-ft. radius curves.

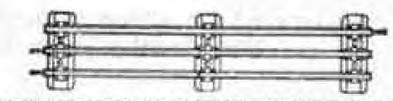
DSR2	Double symmetrical points, right	}	per pair 5/–
DSL2	Double symmetrical points, left	}	

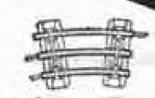
PARALLEL POINTS. For 1-ft. radius curves.

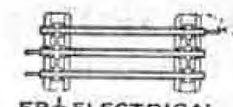
PPR1	Parallel points, right	... }	per pair 5/–
PPL1	Parallel points, left	... }	

PARALLEL POINTS. For 2-ft. radius curves.

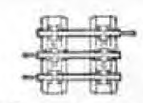
PPR2	Parallel points, right	... }	per pair 5/–
PPL2	Parallel points, left	... }	
RCP	Rail Connecting Plates	... ...	½ doz. 4d.


EB1 ELECTRICAL STRAIGHT RAIL

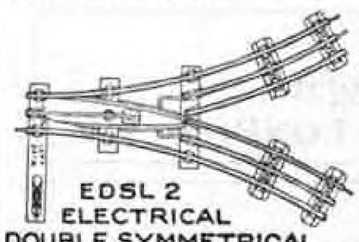

EA1¼ ELECTRICAL CURVED QUARTER RAIL


EB½ ELECTRICAL STRAIGHT HALF RAIL


EA1½ ELECTRICAL CURVED HALF RAIL

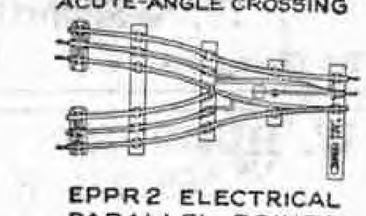

EB¼ ELECTRICAL STRAIGHT QUARTER RAIL

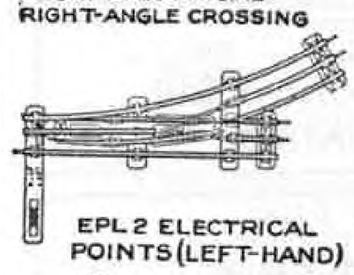

EA1 ELECTRICAL CURVED RAIL


EDSL2 ELECTRICAL DOUBLE SYMMETRICAL POINTS (LEFT-HAND)

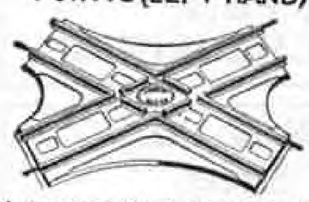

ECA1 ELECTRICAL ACUTE-ANGLE CROSSING

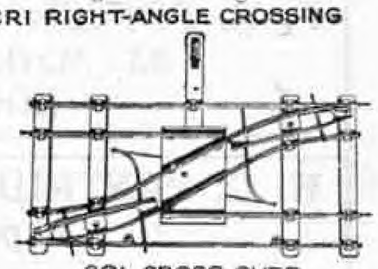

ECR1 ELECTRICAL RIGHT-ANGLE CROSSING


EPPR2 ELECTRICAL PARALLEL POINTS (RIGHT-HAND)


EPL2 ELECTRICAL POINTS (LEFT-HAND)


CR1 RIGHT-ANGLE CROSSING


CA1 ACUTE-ANGLE CROSSING


CO1 CROSS OVER

Rails for Electric Trains

CURVED RAILS.

For 2-ft. diameter circle.

EA1	Curved rails (1-ft. radius)	... per doz.	8/–
EA1½	Curved half rails	„ ... ... „	5/–
EA1¼	Curved quarter rails	„ ... ... „	4/6

For 4-ft. diameter circle.

EA2	Curved rails (2-ft. radius)	... per doz.	8/–
EA2½	Curved half rails	„ ... ... „	5/–
EA2¼	Curved quarter rails	„ ... ... „	4/6

CROSSINGS.

ECA	Acute-angle crossings	... ... each	4/–
ECR	Right-angle crossings	... ... „	4/–

DOUBLE SYMMETRICAL POINTS.

For 2-ft. radius curves.

EDSR2	Double symmetrical points, right	}	per pair 12/–
EDSL2	Double symmetrical points, left	}	

STRAIGHT RAILS.

EB1	Straight rails	... per doz.	7/–
EB½	Straight half rails	... ... „	4/6
EB¼	Straight quarter rails	... ... „	4/–

POINTS.

For 2-ft. radius curves.

EPR2	Right-hand points	... }	per pair 10/–
EPL2	Left-hand points	... }	

PARALLEL POINTS.

For 2-ft. radius curves.

EPPR2	Parallel points, right	}	per pair 12/–
EPPL2	Parallel points, left	}	
TCPH	Terminal Connecting Plates (high voltage)	... ...	each 1/6
TCPL	Terminal Connecting Plates (low voltage)	... ...	„ 1/6

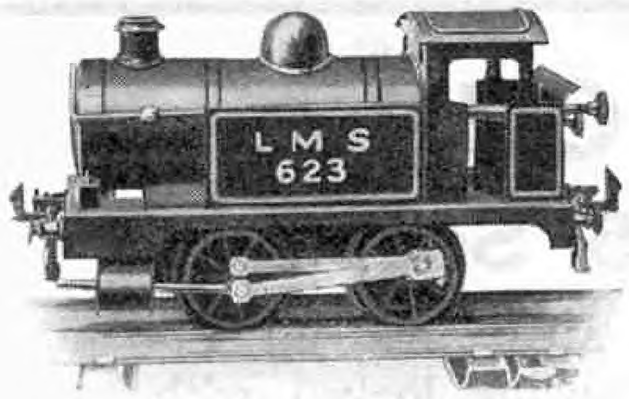
Electrical Points, Double Symmetrical Points and Parallel Points for 1-ft. radius curves are not supplied.

The realistic miniature railway layout shown below is only one of many that can be constructed with Hornby Rails, Points and Crossings. Many similar illustrations and much useful information is given in a new booklet entitled "How to get more fun out of Hornby Trains." This booklet is obtainable from your dealer price 3d. or from Meccano Ltd., Binns Road, Liverpool, price 3d. post free.



Manufactured by MECCANO LTD., Binns Road, LIVERPOOL

HORNBY TANK LOCOS

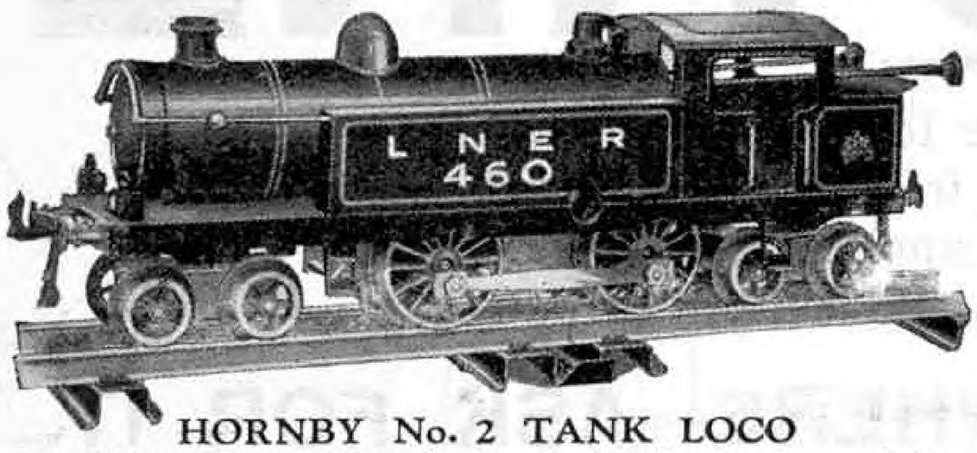


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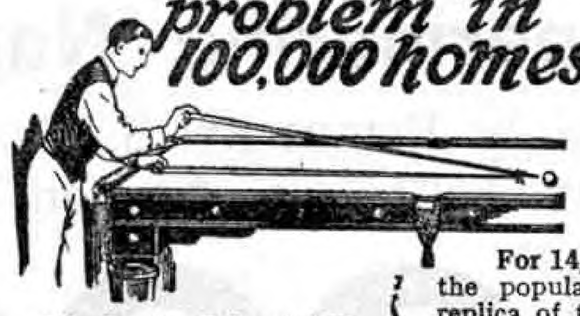
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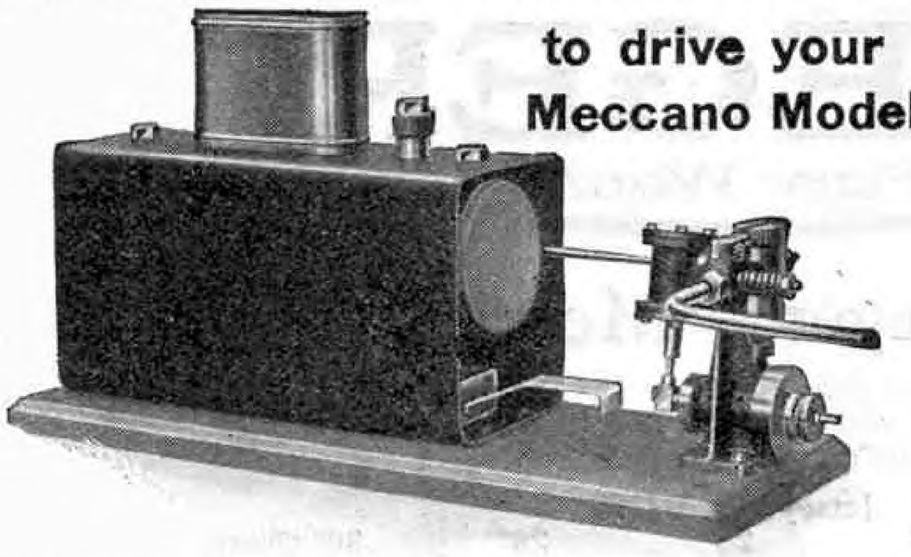


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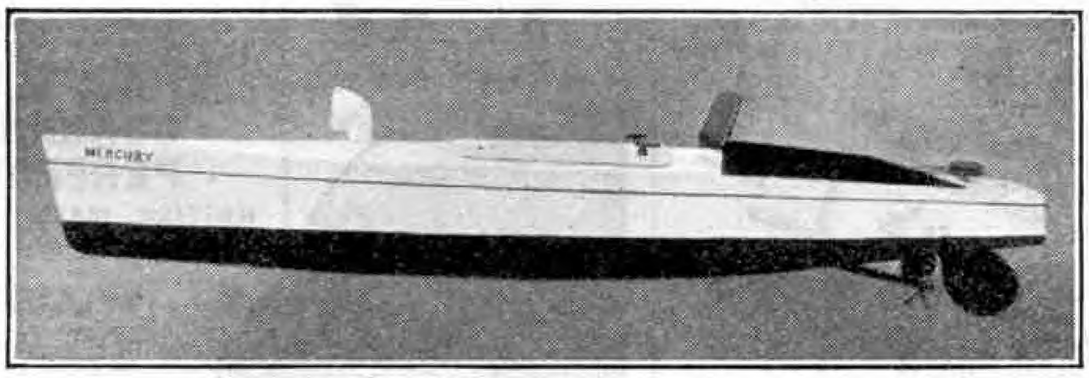
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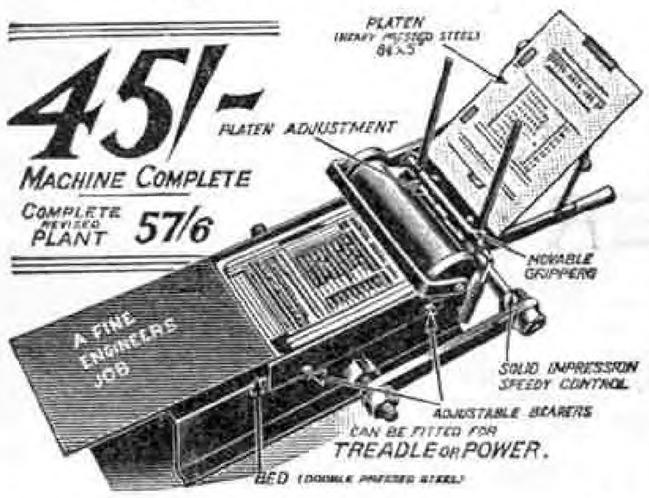
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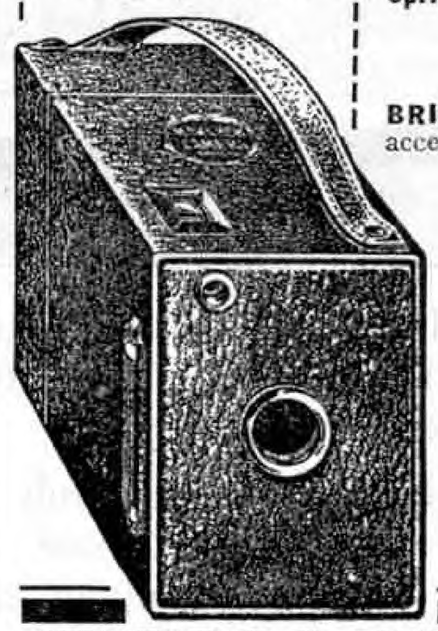
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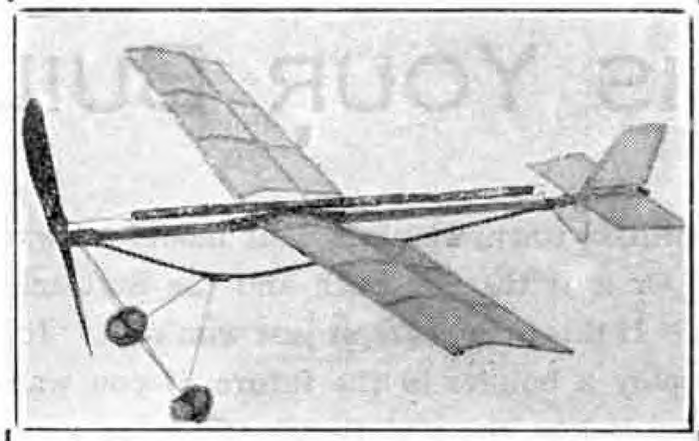
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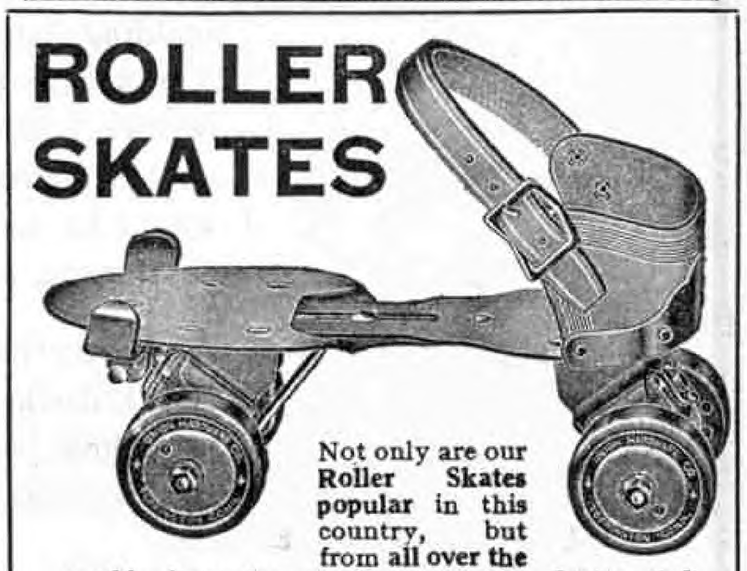
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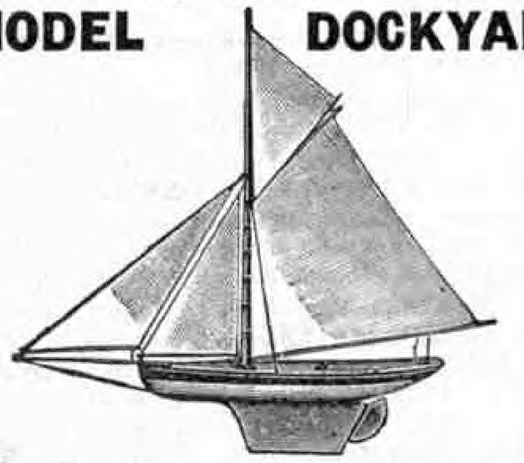
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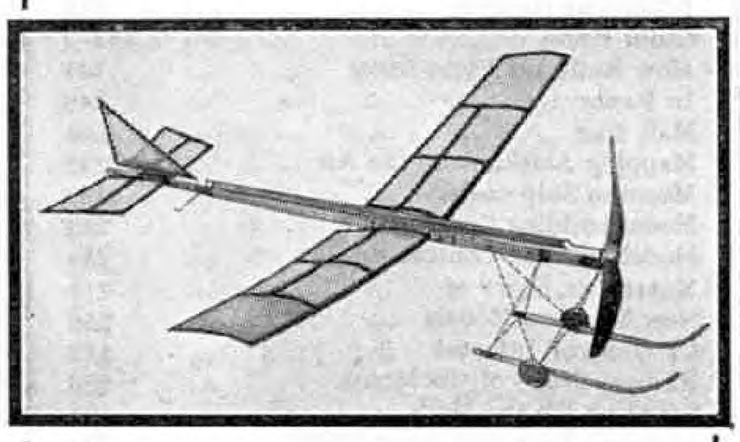
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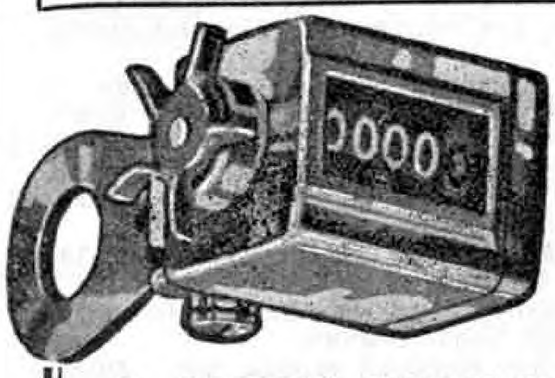
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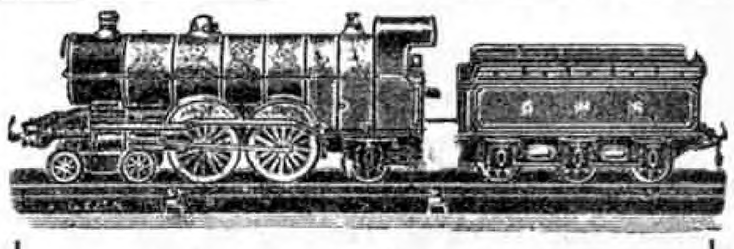
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For Sale. Cheap, Model Railway, Gauge 1, in working order, mostly by Bassett-Lowke, double track mounted on boards, loop line, stations, sidings, signals, etc., with Patriot (4-6-0) type and tank steam working engines, seven passenger coaches, twelve goods wagons. When laid down can occupy space about 27 feet long by 20 feet wide. In first-class condition. Cost new over £60. Can be seen at 25, Shard Road, Meeting House Lane, Peckham, S.E. Offers to—Box 301.

For Sale. Chemical Apparatus and Chemicals, Flasks, Retorts, Bunsen, etc. Also Text-Book. Cost over 25/-. What offers?—Particulars on request.—I. Mackey, Craig Ha, Stevenston, Ayrshire.

Sale. "Meccano Magazines," Jan. 1925 to Dec. 1927 Complete. Perfect Condition. Offers.—Shaw, 100, Brooklands Crescent, Fulwood, Sheffield.

Sale. 800 Stamps, price 6/6.—J. Glover, 25, Deankill Road, East Sheen, London.

For Sale. ½ inch Spark with Commutator and Condenser, 15/- or offer. Also Crystal Set, 8/- or offer.—A. Riley, 80, Marshside Road, Southport.

For Sale. Fine Nine Guinea Model Steam Engine, gas heated, injector, one-eighth horse power. New. £6/10/-.—Box 302.

Hobbies Patterns, 6 lots of 20; 1/6 a lot, postage extra.—F. Elstone, 1a, Railway Road, Abbey Wood, S.E.2.

Gauge 0 Railway for sale; excellent bargains in Bassett-Lowke, Bing, Marklin and Locos, Carriages, Trucks and Rails. Stamp for particulars.—C. Davidson, 50, Grafton Road, Acton, W.3.

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"Boys' Own Paper" (1/- monthly), unbound volumes, 1916-1922 complete. Excellent condition. £1, or offer, volume, lot. Carriage.—J. Bedford, Heol Hir, Llanishen, Cardiff.

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"Chums," "Children's Newspapers," etc. Sale. Send for list, free.—Fowler, Melrose, Gilbert Road, Romford, Essex.

Set English or other Stamps exchanged with any boy outside British Isles.—A. Langdon, Warrington Road, Ipswich, Suffolk.

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RAILWAY PHOTOGRAPHS. Real photo postcards of "*Flying Scotsman*," "*Lord Nelson*," "*King George V*," "*Royal Scot*," 3d. each, or 12 different 2/2, all post free. (Stamps from abroad cannot be accepted). Send for full list.—Railway Photographs, 13, North John Street, Liverpool.

"Meccano Magazines," 1923, 1924, 1925, also some older. Offers. "Mechanical Age," 27-36, 2/-. "Voltalite" Electric Cycle Lamp, almost new, 10/6.—K. Gunn, Birchwood, Gairloch.

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For Sale. Gauge 00 Railway. Stamp for particulars.—L. Wakelin, Oakhurst, Church Lane, Handsworth, Birmingham.

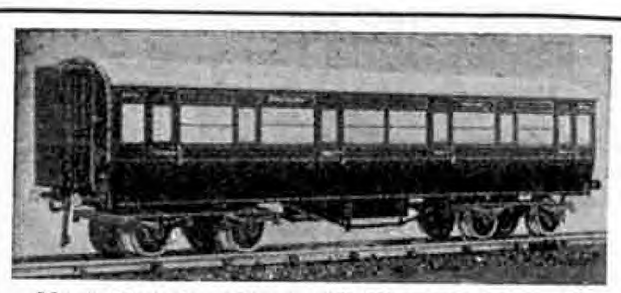
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EDITORIAL AND ADVERTISING OFFICES:—
BINNS ROAD, LIVERPOOL.

Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

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Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper (see important notice below).

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Display. Quotations for space bookings, and latest circulation figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 10th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher Copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

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Sale. Working Model Horizontal Steam Engine, brass, 3-speed pulley. Cost £3/8/-. Gamage Mahogany Case, 34/-. Offers.—Rev. Beere, Laralor, Trim, (Meath).

"*M.M.'s*," Sept.-Nov. 1922, Mar. 1923-Dec. 1927; also Microscope, cost 18/6. Little Nipper Camera, and "Miss America" Launch. What offers?—Tull, 28, Portland Street, Fareham, Hants.

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For Sale. "Boys' Own Annual" and other Boys' Books, for price list apply—BM/FAMW.

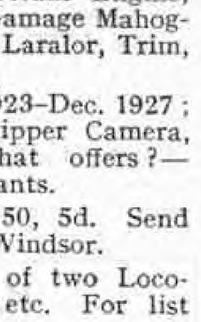
Films Wanted. Comic, Interest and Travel. Must be in good condition and complete. Send 1½d. for list of films for sale.—Hare, 30, Ellys Road, Coventry.

"*M.M.*," May 1923-August 1927. Offers—Box 303.

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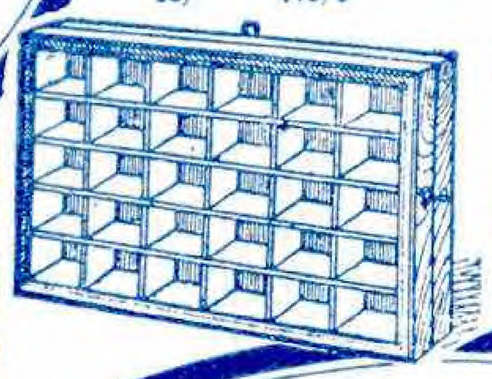
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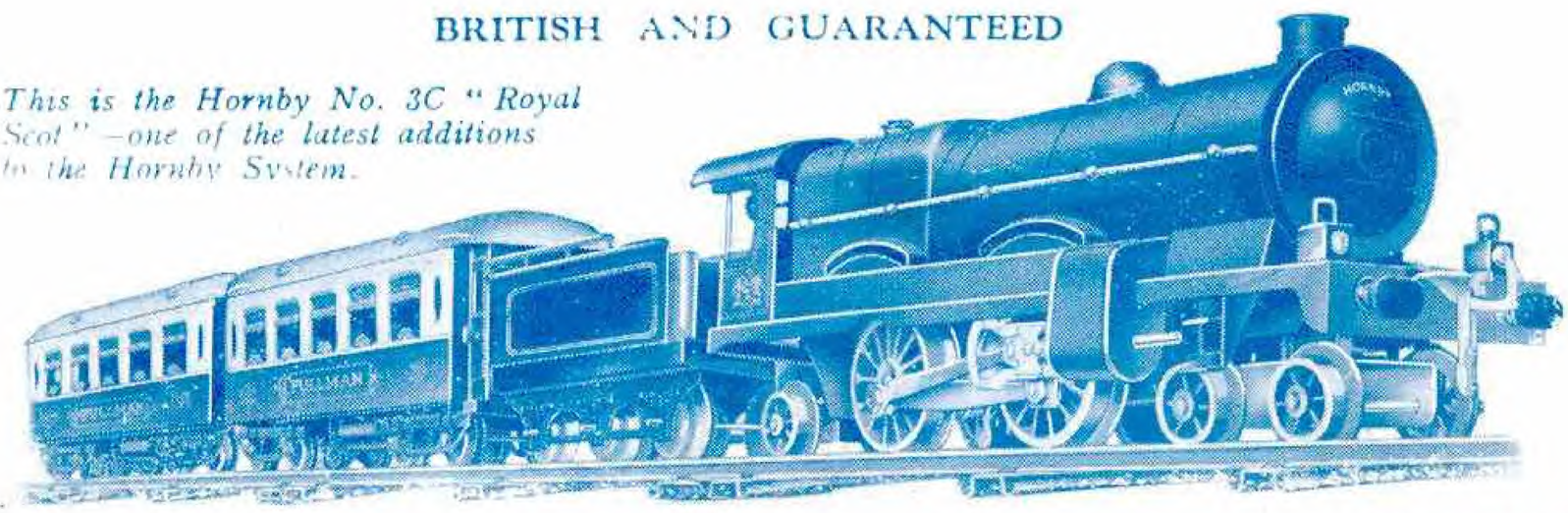
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